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Sublating Tensions in the IT Project Risk Management Literature: A Model of the Relative Performance of Intuition and Deliberate Analysis for Risk Assessment

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Abstract

The information technology (IT) project risk management literature comprises two dominant but diverging bodies of knowledge: the normative and the experiential. We conducted a three-step dialectical review of this literature with the aim of creating a bridging body of knowledge. In the first step, delineation, we synthesize the overarching variance and process explanations in each body of knowledge and motivate the examination of their divergences. In the second step, contrastation, we perform a dialectical interrogation of these bodies to articulate their key assumption-level tensions. We elaborate on the most prominent tension between the two bodies, namely, the relative performance of intuition and deliberate analysis for project risk assessment. In the third step, sublation, we propose a theoretical model that resolves this tension. Anchored in both bodies of knowledge and drawing from managerial decision-making research, the model proposes that the relative performance of intuition depends on characteristics of the IT project manager (project-specific expertise), the project (risks' temporal complexity and risks' structural complexity), and the project's organizational environment (e.g., stakeholders' involvement in risk management, methods-using pressures). Moreover, the model posits that project-specific expertise moderates all the other effects. Building on the bridging knowledge insights from this model, we discuss how researchers can design interventions to increase project managers' use of deliberate analysis when it is expected to outperform intuition or to encourage reliance on intuition when it is likely to outperform deliberate analysis.

Keywords: IT Project Risk Management, Literature Review, Conceptual Assumptions, Grounded Theory Literature Review Method, Dialectical Review, Sublation

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1 Introduction

A longstanding objective of information technology (IT) project risk management research has been to advance knowledge useful for developing risk management prescriptions to guide IT project managers (ITPMs) (e.g., Alter & Ginzberg, 1978; Boehm, 1989; Keil, Cule, Lyytinen, & Schmidt, 1998; Taylor, Artman, & Woelfer, 2012). Such attempts are motivated by the enduring issue of the low success rate of IT projects (Charette & Romero, 2015) and supported by studies that found that appropriate risk response enactment is conducive to project success (Barki, Rivard, & Talbot, 2001). The ultimate objective of this review is to stimulate future research that will advance this kind of knowledge.

Currently, there are two key bodies of knowledge in this area. The first is normative knowledge, anchored in decision theory-based risk management (e.g., expected utility theory, von Neumann & Morgenstern, 1947). Normative knowledge is developed chiefly by academics and is disseminated to practitioners through formal prescriptions (Kutsch & Hall, 2010; Taylor, 2006), which have received some empirical support for their effectiveness (e.g., Barki et al., 2001; Jiang & Klein, 2000; Wallace & Keil, 2004). Over the years, many prescriptions have been incorporated into project management training materials (e.g., PMBoK by PMI, 2013) and advanced in practitioner-oriented journals (e.g., Boehm, 1991; Nelson, 2007).

The second knowledge base is experiential knowledge, which is created and held by ITPMs in their day-to-day experiences. This knowledge, ensuing from how risks are actually managed, is captured by academics who "search for sense in behavior" (March, 1978, p. 604). Studies on experiential knowledge are few but have gained growing attention in recent years (Kutsch & Hall, 2010; Kutsch, Denyer, Hall, & Lee-Kelley, 2013). In doing so, researchers have drawn from theories such as prospect theory (Kahneman & Tversky, 1979) or the seminal works of scholars such as March (March, 1978; March & Shapira, 1987) and Simon (1972, 1987).

Despite some similarities, the normative and experiential bodies of knowledge have differing conceptualizations of core constructs and of their relationships. Accordingly, they sometimes result in significantly contrary risk assessments (e.g., no risk vs. severe risk) and risk response plans (e.g., action vs. inaction) (Bannerman, 2008; Drummond, 1996; Taylor et al., 2012), which can have severe implications for the success of IT projects. Moreover, attempts to make ITPMs fully apply normative prescriptions are sometimes unsuccessful, as many ITPMs, although trained with such prescriptions, disengage from applying them (Kutsch & Hall, 2009) or might practice them in a decoupled fashion just to gain legitimacy (Mignerat & Rivard, 2012).

Given such diverging views of risk management, most researchers have chosen one as the foundation for advancing risk management knowledge and deriving prescriptions, the majority drawing on normative knowledge. However, taking a side can lead to performance issues. Whereas overreliance on normative prescriptions can lead to IT project failures (Drummond, 1996), relying exclusively on experiential knowledge can result in erroneous risk estimations (Kutsch & Maylor, 2011).

Accordingly, some researchers have alluded to the possibility of a contingent performance for each knowledge type (e.g., Baskerville & Stage, 1996; Taylor, 2007; Taylor et al., 2012). For example, this can be achieved by capturing managerial intuitions at the beginning of a risk assessment effort and later using tool-based analytical risk assessments to complement intuitions (Baskerville & Stage, 1996). We suggest that this perspective would enable creating a new knowledge type—bridging knowledge—which has several merits. First, by adopting an initially neutral position on the gap between normative and experiential knowledge, it recognizes the need for future research to identify their relative performance (Taylor, 2005). Second, it provides a significant opportunity for theory building by considering the contingent relative performance of each approach (Taylor, 2007). Third, it can contribute back to practice by guiding researchers in developing new prescriptions of increased practical usefulness (e.g., Taylor et al., 2012). Nonetheless, coherent development of bridging knowledge has been lacking to date.

In this review, we aim to stimulate research on developing bridging knowledge by providing a deep understanding of the normative and experiential bodies of knowledge and reconciling their most salient tension. To this end, considering that generating such novel knowledge is a dialectical process (Nicolai & Seidl, 2010), we take a dialectical review approach comprising the three steps of delineation, contrastation, and sublation. This dialectical approach led us to propose a theoretical model of the relative performance of intuition and deliberate analysis for risk assessment. Anchored in two bodies of knowledge drawn from the managerial decision-making literature (Dane & Pratt, 2007; Salas, Rosen, & DiazGranados, 2010), the model postulates that the relative performance of intuition depends on ITPMs' characteristics (project-specific expertise), project characteristics (risks' temporal complexity and risks' structural complexity), and organizational characteristics (e.g., stakeholders' involvement in risk management, methods-using pressures). The model also posits that project-specific expertise moderates all other proposed effects.

We make three contributions to the IT project risk management literature. First, the delineation step adds to the scarce reviews in this area (e.g., Bannerman, 2008) by synthesizing both bodies of knowledge by discussing their core constructs and developing their overarching models, thus providing a solid foundation for future research. Second, the contrastation step adds to the ongoing discussions of risk management assumptions (de Bakker, Boonstra, & Wortmann, 2010; Kutsch & Hall, 2009; Taylor et al., 2012) by bringing systematicity and structure to the articulation of the assumptions specific to each knowledge type and thus identifying a dominant assumption. Third, the sublation step adds to the rare studies that allude to contingent performance for each knowledge type (e.g., Taylor, 2007) by offering a new theoretical model of the relative performance of intuition. Overall, as we embark on the need for more bridging research (research that addresses current knowledge tensions without assuming either side as universally better), we expand—rather than simply extend—the calls for more normative (e.g., Sauer, Gemino, & Reich, 2008; Schmidt, Lyytinen, Keil, & Cule, 2001) or experiential (Kutsch et al., 2013; Lauer, 1996) research.

We also contribute to methodology by offering a three-step dialectical review approach of two contrasting bodies of knowledge. Particularly, in the contrastation step, we contribute to research that examines alternative conceptual assumptions (e.g., Alvesson & Sandberg, 2011; Davis, 1971) by introducing a coherent approach that adapts the grounded theory literature review method (Wolfswinkel, Furtmueller, & Wilderom, 2013) and treats papers as data, the manifestations of assumptions in papers as open codes, and the articulated assumptions as axial/selective codes.

We begin this paper by explaining in more detail our three-step dialectical approach.

2 Review Approach

Figure 1 shows our dialectical review approach. We defined a review protocol and then took the three consecutive steps of delineation, contrastation, and sublation. Each step of this process is explained below.

2.1 Review Protocol

We used a review protocol to conduct a systematic literature review (Boell & Kecmanovic, 2015). We searched online databases (Business Source Complete on EBSCOHost and ABI/INFORM on ProQuest) for the term "risk" in the titles and abstracts of articles published between 1990-2016 in the AIS Senior Scholars' basket of eight journals. For an initial screening, we examined the abstracts to verify relevance and kept only peer-reviewed papers. For each retained paper, we next searched forward and backward (Webster & Watson, 2002), expanding our initial set of journals.

This resulted in identifying 268 papers (Table 1). We then read the abstracts, introductions, and conclusions of these papers and included those that focused on: (1) ITPMs, as they have risk management as part of their function (PMI, 2013); (2) in-house—not outsourced—IT projects, to limit the variation on the nature of risk management and the role of ITPMs; and (3) project risks, but not the financial risks of investing in a project (e.g., Dewan, Shi, & Gurbaxani, 2007) or the business risks of the delivered system, to focus on the risks that are more likely to be under the control of ITPMs. This yielded 137 papers.

Because the papers pertaining to the normative body of knowledge dominated this pool, we used practical screening (Okoli, 2015) and balanced the number of papers from each type of knowledge to enable creating dialectical forces of comparable size. We labeled each paper either "normative" or "experiential" on the basis of the knowledge type most pronounced in it. When both types were significantly discussed (e.g., Lyytinen, Mathiassen, & Ropponen, 1998), we labeled the paper "mixed" (see Appendix A for the coding scheme). Among the 137 papers, 88 (64%) related to normative knowledge, 18 (13%) were mixed and 31 (23%) related to experiential knowledge. We kept all 31 papers with an experiential label, all 18 that were mixed, and the top 31 influential studies with a normative label (using their Google Scholar citation count as of October 2016), retaining 80 papers in total. Although we distinguished the two knowledge types at the paper-level to create a manageable pool, our level of analysis was an excerpt within a paper.

2.2 Delineation

The delineation step consisted of a theme-based literature review (Webster & Watson, 2002) addressing the question of what each body of knowledge yielded. This involved a concept-centric synthesis that identified and defined the core constructs in each body of knowledge and two effect-centric syntheses that integrated key variance and process relationships. To manage the logistics of this analysis, we imported the papers as data sources in NVivo 11 and coded their constructs and relationships. In addition to delineating each body of knowledge, this step implied the existence of some dialectical tensions.

2.3 Contrastation

The contrastation step involved articulating dialectical tensions within the pool of papers. Because tensions refer to dichotomies or inconsistencies that appear to originate from contradictory extremes (Bartunek & Rynes, 2014), the two bodies of knowledge were analyzed to identify pairs of divergent assumptions about a key risk management theme. This focus on assumptions has two motivations. First, it has been suggested that awareness of normative assumptions is crucial to understanding why prescriptions from the normative body of knowledge are sometimes difficult to apply in actual IT projects (Taylor et al., 2012). Second, such assumptions are insufficient for building further reconciling theories that go beyond the normative view and span the experiential knowledge domain.

To identify tensions, we conducted dialectical interrogation (Alvesson & Sandberg, 2011), which involved reading the papers in depth and iteratively comparing each unit of meaning about risk management in them with other relevant excerpts to allow the emergence of tensions. Our analysis was based on the premise that an assumption can have multiple *manifestations*—i.e., it is stated in different but essentially related ways.

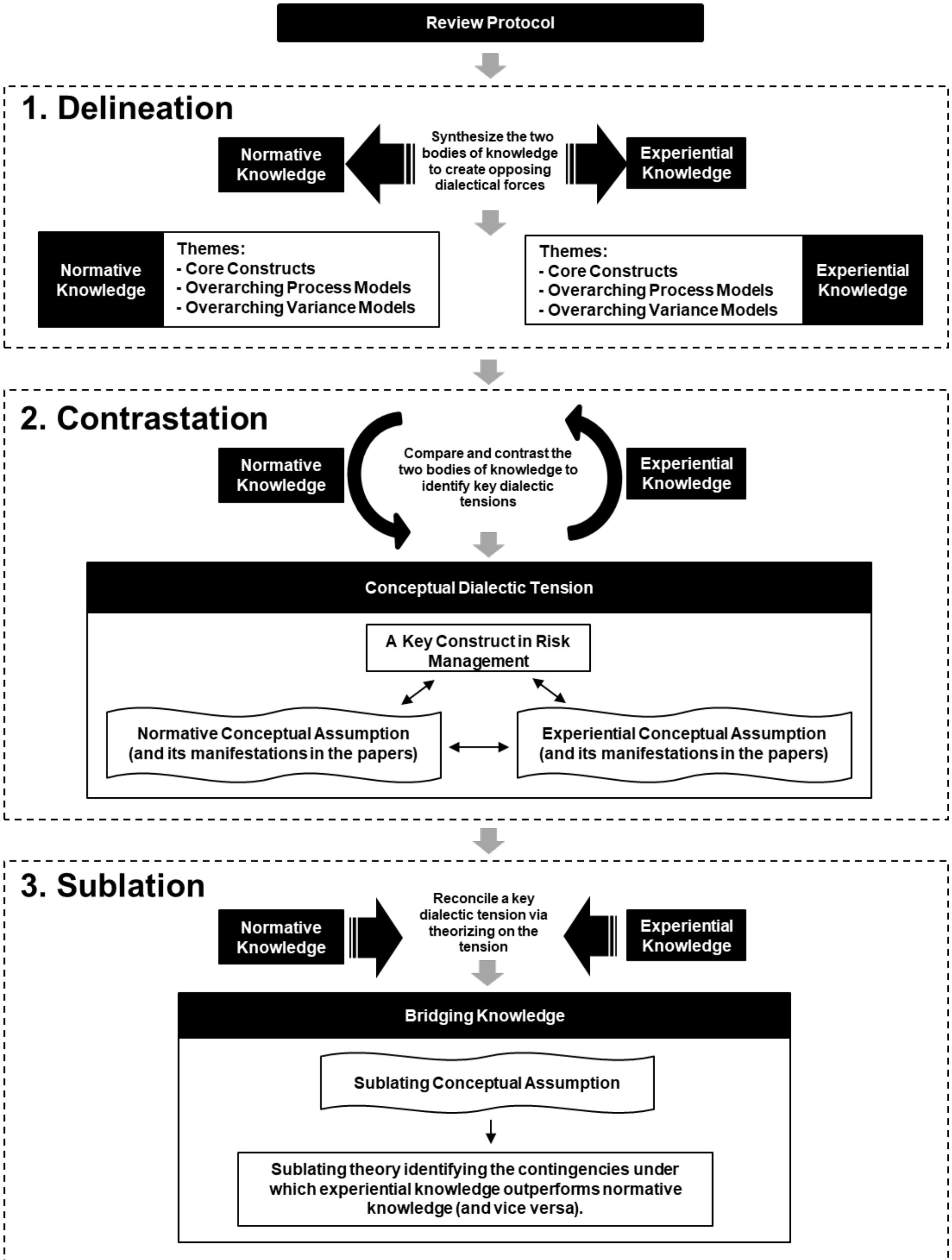


Figure 1. A Three-Step Dialectical Review Approach

Table 1. The Composition of the Pool of Papers in Terms of Publication Outlets

Source	Papers identified in the initial search	Papers retained after applying the inclusion/ exclusion criteria	Papers kept
Journals in the AIS basket of 8	**64**	**28**	**28**
European Journal of Information Systems	9	5	5
Information Systems Journal	6	3	3
Information Systems Research	3	2	2
Journal of Information Technology	17	10	10
Journal of Management Information Systems	13	5	5
Journal of Strategic Information Systems	2	0	0
Journal of the Association for Information Systems	2	2	2
MIS Quarterly	12	1	1
Other journals with > 4 papers initially identified	**121**	**71**	**35**
Communications of the ACM	14	7	5
Communications of the AIS	5	4	2
IEEE Software	28	19	7
IEEE Transactions on Engineering Management	11	3	0
IEEE Transactions on Software Engineering	10	3	1
Information & Management	6	4	3
International Journal of Project Management	11	7	6
Journal of Systems and Software	25	16	7
Project Management Journal	11	8	4
Other publication outlets	**83**	**38**	**17**
Total	**268**	**137**	**80**

Also, we considered that whereas in some papers the manifestations are empirically evidenced, in others they are taken for granted as true. Moreover, we considered that while sometimes such manifestations are explicitly visible in the excerpts, often they are implicit. For example, a manifestation that we discussed is: "Deliberate analysis increases the accuracy of risk estimates". It is explicit in the statement that research on risk assessment tools holds "the assumption that the use of such devices will lead to more accurate risk perceptions" (Keil, Wallace, Turk, Dixon-Randall, & Nulden, 2000, p. 145); however, it is implicit in the argument that "with a risk factor checklist, project managers can avoid overlooking some risk factors" (Schmidt et al., 2001, p. 8).

To ensure consistency, we used the coding techniques of grounded theory applied to literature reviews (Wolfswinkel et al., 2013). With the papers in NVivo 11, we conducted open, axial, and selective coding (Strauss & Corbin, 1990). In open coding, we coded any potential manifestations in the papers. Here, we created and used some initial codes from the literature on risk management assumptions inside (e.g., de Bakker et al., 2010; Kutsch & Hall, 2009) and outside information systems (IS) (e.g., March & Shapira, 1987; see Appendix D). During axial coding, we articulated many tensions around themes about which we had coded several opposing experiential and normative manifestations, and then transformed the commonality of each experiential and normative group of manifestations into a more abstract assumption. Finally, in selective coding, we purified the tensions and merged some of them in a manageable way. One author coded the entire pool; the other verified 10% of the codes for each manifestation. The few discrepancies were discussed until resolved, and the outcomes of this resolution were applied to the rest of the sample. We coded all 80 articles, although we reached saturation after analyzing 72 papers. After identifying three key tensions, we chose to focus on and explain the most salient one in order to promote rich development followed by focused sublation.

2.4 Sublation

The contrastation step revealed a salient dialectical tension between the two bodies of knowledge. Instead of treating these knowledge bases as forces that are polarized one against the other (Bartunek & Rynes, 2014), we aimed at creating a bridging knowledge that considers a contingent performance for each side. We thus developed a sublating assumption and a theoretical model that explains when each knowledge type outperforms the other by drawing from relevant management and IS literature. We also discussed how such a theoretical model, of course subject to empirical validation, translates to some avenues for future prescriptive risk management research.

3 Delineation Findings: What Did We Learn from Each Body of Knowledge?

We synthesized each body of knowledge along its core constructs and main research models. Our review revealed some commonalities.

First, both bodies of knowledge include the core constructs of risk and risk response. In most studies, risks are concerned with undesired events and thus do not cover positive outcomes (e.g. Barki, Rivard, & Talbot, 1993; Boehm, 1991). A key undesired event is project failure caused by deviations from project objectives (e.g., Barki et al., 2001). In some studies, the undesired event is an intermediary event (e.g., user-team conflict) that will later impact project objectives. Studies on both normative and experiential knowledge refer to the causes of undesired events (e.g., project characteristics such as complexity) as risk sources (Powell & Klein, 1996), risk items (Boehm, 1991; Keil, Li, Mathiassen, & Zheng, 2008), or risk factors (Barki et al., 1993). A risk response is a project management activity enacted to deal with specific risk sources or undesired events. Enacting a risk response is likely to change the state of a project (Charette, 1996a) by either modifying the existing managerial activities (e.g., adopting an agile development approach rather than a traditional one) or performing extra activities (e.g., liaising with user representatives). In dealing with risks, risk responses can serve three purposes: avoidance, mitigation, or transfer (Charette, 1996a; Heemstra & Kusters, 1996). Among these, risk mitigation is the most proactive way of responding to risks. It aims at reducing the likelihood of undesired events by reducing or eliminating risk sources and/or limiting their negative impact if they do occur. When no risk response is enacted, risks are being accepted.

Second, both bodies of knowledge examine risks and risk responses at different levels of aggregation. For example, individual risk factors are combined to estimate the overall project risk (Wallace, Keil, & Rai, 2004a) or risk exposure (Barki et al., 2001). Likewise, while some risk responses target specific areas of a project (e.g., increasing user participation), others pertain to the entire project, for example, terminating high-risk projects (Jani, 2011).

Third, both bodies of knowledge have examined risk management using variance and process models. Variance models explain the relationships between risk management constructs such as risks, risk responses, and project performance. Process models look at the sequence of steps in risk management—for example, suggesting whether and how risk responses are enacted after some significant risks have been identified.

Despite such commonalities, the two bodies of knowledge significantly differ in their definitions of constructs and their specification of research models. They thus provide different contributions to our understanding of IT project risk management.

3.1 The Normative Body of Knowledge

Most studies that constitute the normative body of knowledge have relied on classical decision theories such as expected utility theory (EUT) (von Neumann & Morgenstern, 1947) and have conceptualized risk management as decision-making (e.g., Lyytinen, Mathiassen, & Ropponen, 1996). The core constructs of this body of knowledge are presented below and the main learning yielded is synthesized within a process model and a variance model.

3.1.1 Core Constructs

Three risk-related constructs are key in this literature: risk, risk exposure, and residual risk (or residual risk exposure). Risk (used in its specific sense) refers to the probability of undesired outcomes (Barki et al., 2001). Risk exposure refers to expected loss (Barki et al., 1993; Boehm, 1991; Heemstra & Kusters, 1996), which accounts for both the probability of undesired outcomes and their impact if they occur. Residual risk incorporates the risk-reducing effect of enacted risk responses (Jiang, Klein, & Chen, 2006; Nidumolu, 1995).

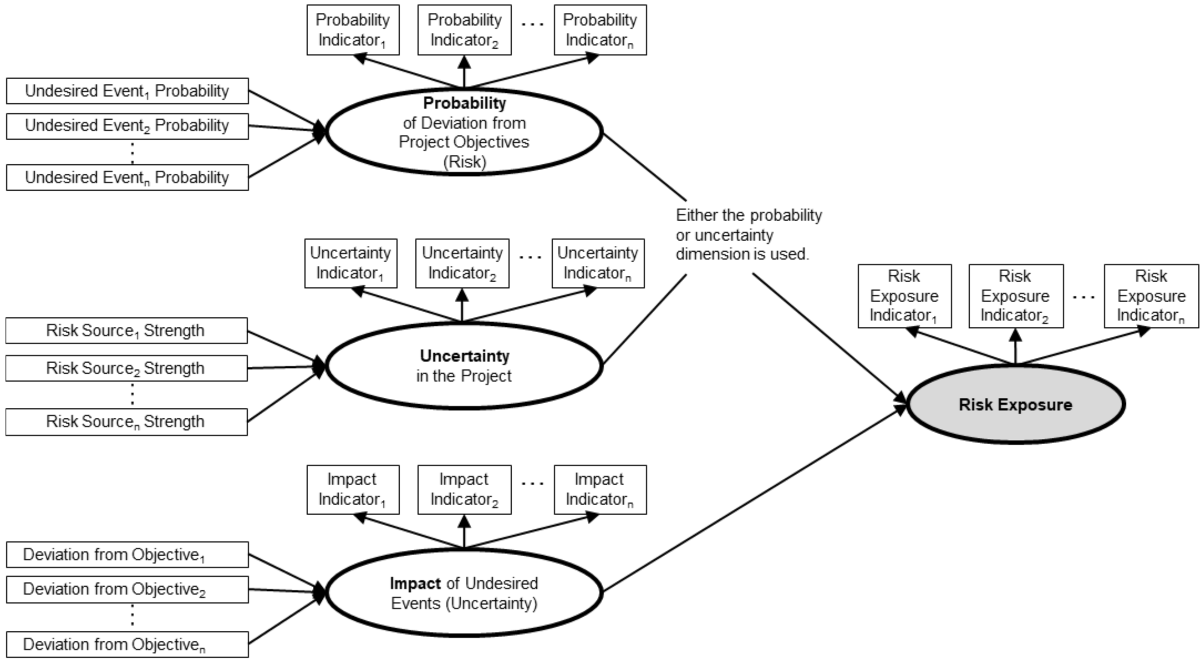


Figure 2. A Synthesis of the Conceptualizations and Operationalizations of Risk Exposure From the Normative Body of Knowledge

Risk assessment is considered an analytical process. Such analysis can be carried out by deliberate thinking. For example, ITPMs can think about what can go wrong because of a specific risk factor. Nevertheless, researchers have dedicated much attention to measuring the risk exposure construct following EUT and its descendants. A second-order MIMIC construct displayed in Figure 2 summarizes these measurement efforts.

Some studies have conceptualized risk exposure as a first-order reflective construct (e.g., Jani, 2011). Others have conceptualized it as a second-order construct with two dimensions: probability of failure (or of undesired events) and impact. While probability can be measured reflectively, it can also be measured formatively using a composite of the probabilities of specific undesired events. When probability is difficult to measure, it is approximated by the level of uncertainty in the project (Barki et al., 1993; Wallace et al., 2004a). One can measure uncertainty using direct indicators; yet to estimate uncertainty formatively, which is more common, a composite of multiple risk sources is used (e.g., Barki et al., 2001). Because formative measurement provides a rich and actionable understanding of a construct, the literature has developed several checklists of risk sources and events in IT projects (e.g., Barki et al., 1993; Keil et al., 2008; Lyytinen et al., 1998; Schmidt et al., 2001). While some lists are generic to most IT projects (e.g., Schmidt et al., 2001), others are tailored to specific project types such as ERP (e.g., Ehie & Madsen, 2005) or specific countries (e.g., Mursu, Lyytinen, Soriyan, & Korpela, 2003). To make such lists manageable, risk sources are ranked in order of importance (e.g., Boehm, 1991) or are combined into fewer categories (e.g., Wallace, Keil, & Rai, 2004b). Categorization is performed using theories such as a sociotechnical model of software development (e.g., Lyytinen et al., 1998), methods such as cluster analysis (e.g., Wallace et al., 2004b), perceptions such as perceived level of controllability and/or importance of risks (e.g., Keil et al., 1998; Mursu et al., 2003), temporal characteristics such as a priori versus emergent nature of risks (Gemino, Reich, & Sauer, 2008), or project phases (e.g., Powell & Klein, 1996). Taken together, these lists suggest that, while technology-related risks are important, user risks (e.g., user resistance) and top management support are major issues (Keil et al., 1998; Schmidt et al., 2001).

The second dimension of risk exposure is the impact of risks. Reflectively, impact indicators can be derived from risk archives, brainstorming, or ITPMs' perceptions. Formatively, one can identify various impacts of risks and assign a magnitude of impact values to the risk events. Risk impacts are usually conceptualized as the extent of deviation from various specified project objectives (Barki et al., 2001). Traditionally, project objectives are specified using the three dimensions of time, cost, and scope; but more recently, stakeholder satisfaction and acceptance have also been considered (de Bakker et al., 2010; Jiang & Klein, 1999).

The next step in assessing risk exposure is to combine the two dimensions. Following the expected utility formula in EUT, many have done so by multiplying the measured probability (or uncertainty) and impact values (Barki et al., 1993; Baskerville & Stage, 1996; Boehm, 1991; Charette, 1996a), thus creating a multiplicative multidimensional construct (Law, Wong, & Mobley, 1998). This can be done by a manual calculation or by using a software tool that embeds the formulae (e.g., Du, Keil, Mathiassen, Shen, & Tiwana, 2007).

In a comprehensive measurement of risk exposure, Barki et al. (2001) measure this construct simultaneously as a first-order construct in a reflective fashion (using criterion variables) and as a multiplicative second-order construct (using formative items for each uncertainty and impact dimension).

While much research attention is paid to defining and measuring risks, as also noted by de Bakker et al. (2010), not very much has been said about risk responses. In discussing risk responses, researchers have addressed the question of what should be the response to a specific risk source (Lyytinen et al., 1998) and have offered lists of heuristics that associate risk sources with risk responses (e.g., Addison & Vallabh, 2002; Baccarini, Salm, & Love, 2004; Baskerville & Stage, 1996; Boehm, 1991; Keil et al., 1998; Lyytinen et al., 1998; Moynihan, 2002; Sumner, 2000; Tesch, Kloppenborg, & Frolick, 2007). Three broad categories of risk responses are internal integration (dealing with project teams), external integration (with end users), and formal planning (e.g., Barki et al., 2001; Gemino et al., 2008; Mignerat & Rivard, 2012). These categories have been used to measure a project's risk management profile as a multidimensional construct (Barki et al., 2001).

3.1.2 Process Studies

A central theme in the normative body of knowledge is the formal risk management process, portrayed as comprising several phases required to ensure risk assessment and control (Charette, 1996a). The generic process, adapted from the choice process in classical decision theories, is presented in Figure 3. It captures essential elements of several prescribed processes (e.g., Charette, 1996a; Fairly, 1994; Heemstra & Kusters, 1996; Powell & Klein, 1996) especially from Boehm (1991). Table C1 in Appendix C presents the studies that mention each step, and other reviews of the processes are available in Kutsch and Hall (2009, p. 73, Table 1) and Bannerman (2008, p. 2121). Our analysis suggests that risk management often includes the two major steps of risk assessment and risk control. Risk assessment involves (*S1*) risk identification (e.g., using a risk checklist to identify risk sources in a project); (*S2*) risk analysis (i.e., estimating the risk exposure of each of the identified risk sources, for example, by analyzing probabilities and impacts); and (*S3*) risk prioritization (i.e., using risk exposure to rank risks in the order of deserved attention). Risk control comprises (*S4*) risk response planning (e.g., using heuristics lists to choose risk responses); (*S5*) risk response enactment (implementing risk responses to deal with risks); and (*S6*) risk monitoring, in which risks and the planned responses are kept in a risk register (log) and are reviewed over the course of the project to ensure proper implementation. The entire process is frequently iterated as a cycle (*S7*).

3.1.3 Variance Studies

Several studies within the normative body of knowledge have theorized on and tested relationships between risks, risk responses, applying formal risk management practices, and project performance. Their key findings are synthesized in Figure 4.

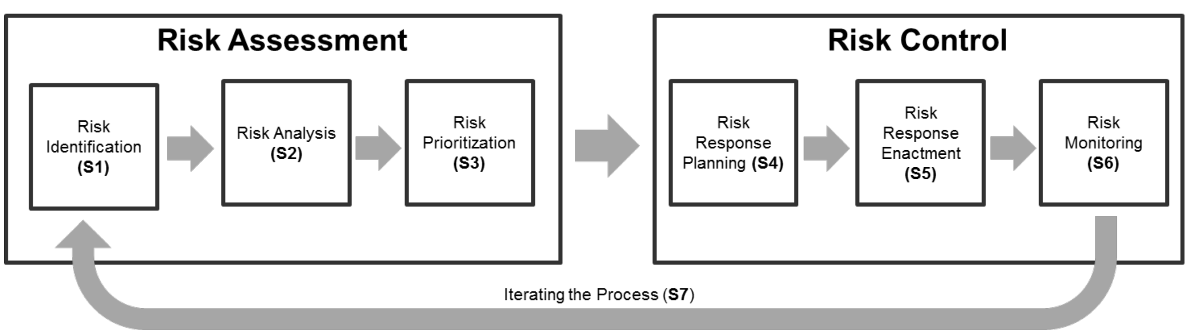


Figure 3. A Process Model of IT Project Risk Management Derived From the Normative Body of Knowledge (Adapted From Boehm, 1991)

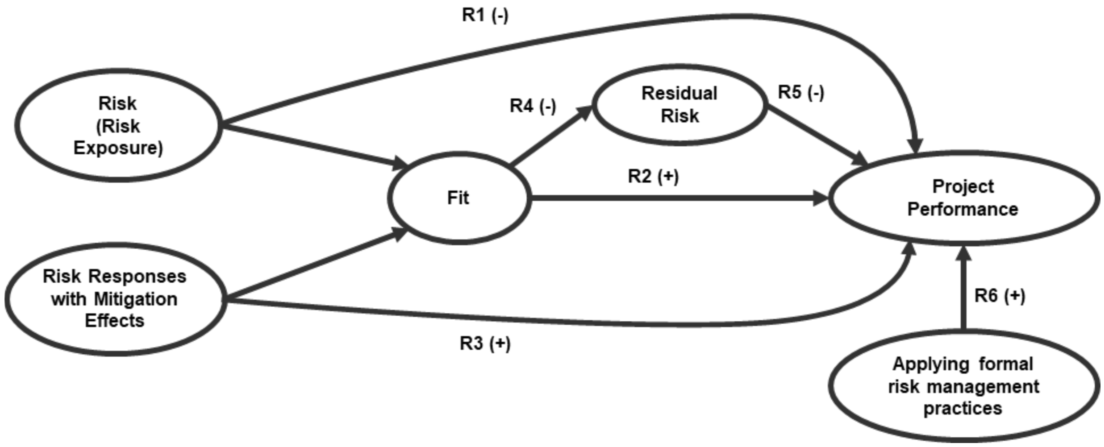


Figure 4. A Synthesized Variance Model of IT Project Risk Management From the Normative Body of Knowledge

As indicated by *R1(-)* in the model, risks negatively impact project performance (e.g., Nidumolu,1996; Wallace et al., 2004a). This negative impact can be direct (Jiang & Klein, 2000) or mediated through intermediary risks (Jiang et al., 2006; Gemino et al., 2008; Wallace et al., 2004a). For example, social and technical risks influence project success via project management risks (Wallace et al., 2004a). Research suggests that specific risk responses can increase project performance if they fit with risks—*R2(+)*. Fit has been examined in two ways. First, it has been identified theoretically, as a heuristic match between some specific risks and risk responses—that is, a presumably effective managerial intervention (Lyytinen et al., 1996; Lyytinen et al., 1998).

Second, fit has been identified empirically, using calibration samples to determine what risk responses are appropriate for which risk exposure levels and which project performance criteria (product or process) (Barki et al., 2001). Without considering such a contingent fit, studying the direct impact of risk responses on project performance (*R3+*) resulted in mixed findings (Nidumolu, 1996). When there is a fit, risk responses contribute to project performance by reducing residual risk (*R4-*) that will have a weaker negative effect on project performance (*R5-*) than untreated risks (*R1-*) (Jiang et al., 2006; Nidumolu, 1995). Research also suggests that applying a formal risk management process decreases some project risks and impacts project performance (*R6+*) (Ropponen & Lyytinen, 1997), especially because it offers a communicative action that enables project stakeholders to talk about risks (de Bakker, Boonstra, & Wortmann, 2011). Also, *R6(+)* has an inverted-U shape, in that it has been shown that very low levels of risk management and very high levels of risk management deter project performance (Ropponen & Lyytinen, 1997). Table C2 in Appendix C details the findings of each relevant study in our pool.

3.2 The Experiential Body of Knowledge

The experiential body of knowledge is based on the premise that understanding the nature of IT project risk requires studying ITPMs' risk judgments (Lauer, 1996). Our review yielded a relative scarcity of studies adopting an experiential perspective, aiming to understand how ITPMs manage risks and why they sometimes do so differently from normative prescriptions. Below we present the core constructs from this literature and synthesize its key process and variance findings.

3.2.1 Core Constructs

A core construct in this literature is perceived risk (or risk perception). Drawing from Sitkin and Pablo (1992), researchers have defined perceived risk as "the belief that there exist sources of risk with potential to adversely affect project outcomes" (Du et al., 2007, p. 272). Like the notion of risk exposure, risk perception has been conceptualized as reflecting both the probability of undesired events and the loss associated with their occurrence (Du et al., 2007). There are indications, however, of the difference between the risk perceptions of ITPMs and risk exposure as defined in the normative body of knowledge. First, ITPMs often focus on few but not many risk factors (Schmidt et al., 2001). Second, as compared to the normative definition of risk exposure, ITPMs' risk perceptions focus on the impact rather than the probability of occurrence of risk events (Keil et al., 2000); Third, for ITPMs, there might be more dimensions to risk perception, including uncontrollability (Keil et al., 1998; Mursu et al., 2003; Pablo, 1999), lack of information (Pablo, 1999), and the timing of a loss occurrence (Kutsch et al., 2013). Most attempts to capture the level of perceived risk use self-reports with reflective indicators (e.g., Du et al., 2007); however, recent neuroscience studies of risk perception motivate more objective ways of measuring it (e.g., Volz & Gigerenzer, 2012).

Lists of ITPMs' perceived risks have been compared across individuals (Moynihan, 1997), across ITPMs from different countries (Schmidt et al., 2001), to the risk lists in the normative body of knowledge (Moynihan, 1996; 1997), with other stakeholders such as senior executives (Liu, Zhang, Keil, & Chen, 2010), and with users (Keil, Tiwana, & Bush, 2002). It appears that ITPMs differ significantly in terms of the risk factors they attend to (Moynihan, 1997). Moreover, although there is an overlap between the risk sources that ITPMs perceive to be recurring and the risk sources covered by influential normative studies, ITPMs also raise issues that have received little attention in the normative body of knowledge, such as the extent of control over a project or the source of project control (Moynihan, 1996).

Also, the literature highlights the specific risk responses that ITPMs enact (Liu et al., 2010; Moynihan, 2000; Tesch et al., 2007), which are sometimes different from those of other sources (e.g., senior executives; Liu et al., 2010). At the project level, three commonly studied risk response decisions of ITPMs are: accepting to undertake a project (Lauer, 1996), continuing with a project (Keil et al., 2000), or applying formal risk management prescriptions in a project (Kutsch & Hall, 2009). Research suggests that deliberate risk ignorance, especially in the form of waiting to see what will happen and dealing with it if it happens, is a common risk response (Kutsch & Hall, 2005).

3.2.2 Process Studies

It has been noted that normative studies have largely assumed that ITPMs will—most likely—use normative prescriptions (de Bakker et al., 2010). However, experiential studies find that ITPMs often disengage from most normative prescriptions over time. In terms of the overall process, one study of ITPMs found that they considered risk management a "box-ticking" exercise, which suggests that they did not consider it a worthwhile practice (Kutsch & Hall, 2005). Moreover, studies have found that the majority of the ITPMs surveyed did not follow any risk management approach (Ropponen, 1999). Disengagement from formal risk management can happen at any point in the process. Figure 5 summarizes where these disengagements occur, and Table C3 in Appendix C details the findings in the literature.

The first specific disengagement can happen from a formal risk identification (*D1*). An early study found that risk checklists were used by only 33% of ITPMs (Ropponen, 1999). Kutsch et al. (2013) report that among the 19 ITPMs in their study who planned on managing risks, five did not adopt any practice to identify risks. Yet, another recent study reports that risk identification was conducted in all the projects that were part of the study (de Bakker, Boonstra, & Wortmann, 2012). This supports the argument that some risk management processes are now widely institutionalized (Mignerat & Rivard, 2012). Regarding risk analysis (*D2*), studies have found that many organizations do not explicitly evaluate risk (Armour, 2005), especially in a quantitative fashion (Bannerman, 2008). Kutsch et al. (2013) report that among the 14 ITPMs who performed risk identification, seven did not assess the probabilities and eight did not determine the impacts of risks.

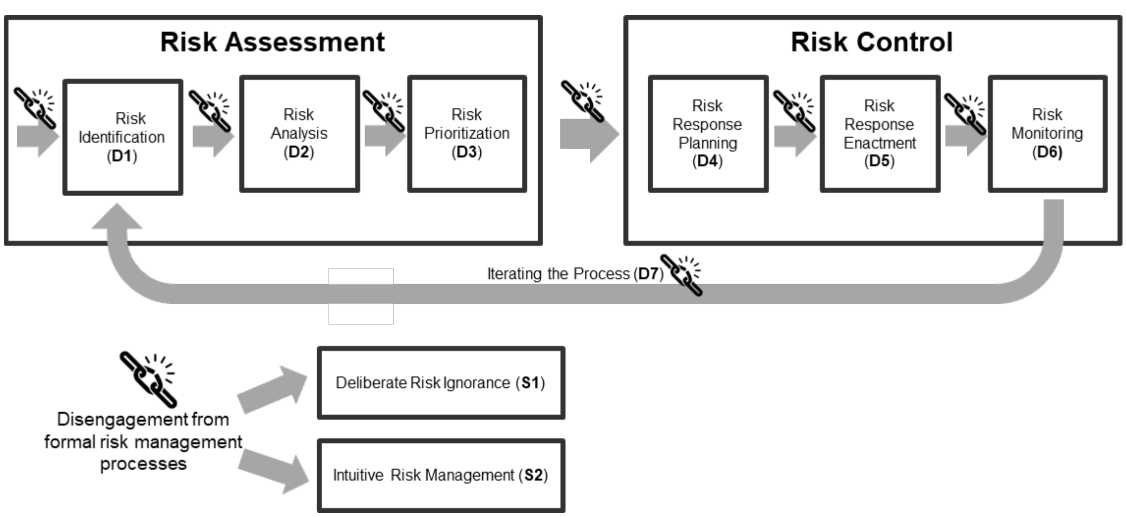


Figure 5. A Synthesized Process Model of Experiential IT Project Risk Management

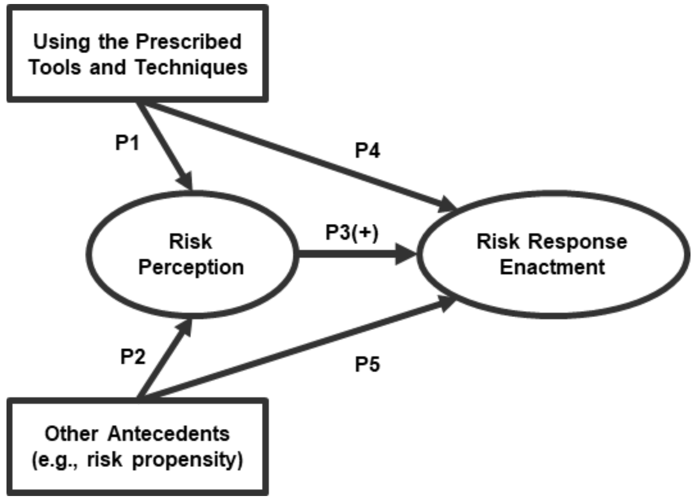


Figure 6. A Synthesized Variance Model of BoK2 Studies of IT Project Risk Management

Likewise, researchers have found that ITPMs felt ambivalence about how accurately risk prioritization was conducted (Bannerman, 2008) (*D3*). Moreover, often risk assessment is not followed by risk response planning (*D4*) (Kutsch et al., 2013; Taylor, 2005). Even when specific risk responses are formally planned, they might never be enacted (*D5*) (Taylor, 2005). Furthermore, ITPMs rarely refer to the risks logged in earlier project stages when taking an action (*D6*) (Taylor, 2005).

Finally, the cycle of risk management is seldom iterated throughout the course of a project (*D7*) (Bannerman, 2008; Carr, 1997; de Bakker et al., 2010); often, the formal risk management process is applied once at the beginning of a project, if at all (Bannerman, 2008).

When ITPMs disengage from normative prescriptions, they might deliberately ignore risks (*S1*) and avoid any action—for instance, by delaying or delegating their risk response decisions (Kutsch & Hall, 2005; Kutsch & Hall, 2010). Alternatively, they might continue to perform risk management (*S2*) in an experiential way— e.g., using intuition (Baskerville & Stage, 1996; Drummond, 1996; Ropponen, 1999). Intuition refers to "automatic and relatively effortless processing and learning of information" (Dane & Pratt, 2007, p. 35) and implies learning from personal experience and developing perceptions without explicit awareness (Dane & Pratt, 2007). It is, therefore, anchored in personal experience and expertise without using tools or techniques.

3.2.3 Variance Studies

Variance studies in the experiential body of knowledge are concerned with the antecedents of risk perception and the risk response enactment decisions of ITPMs (Figure 6). The findings of relevant studies are included in Table C4 in Appendix C. Those studies suggest that the normative knowledge-based prescribed tools and techniques (e.g., risk checklists) have some impact (*P1*) on the risk perceptions of ITPMs; they influence novice ITPMs but not experts (Keil et al., 2008). Researchers have examined the impact of other antecedents on risk perceptions. For example, following Sitkin and Pablo (1992), the impacts of ITPMs' risk propensity on risk perception (*P2*) have been studied, although the results suggest limited (Huff & Prybutok, 2008) or insignificant (Keil et al., 2000) relationships. Similarly, the impact of ITPMs' risk perception on risk response enactment, *P3(+)* is sometimes significant (Keil et al., 2000), but at other times insignificant (e.g., Du et al., 2007). Moreover, normative tools and techniques have no or limited impact (*P4*) on the decision to enact risk responses (Du et al., 2007; Keil et al., 2008). Considering that *P3* and *P4* have limited effects, it seems that ITPMs' risk response behaviors are largely determined by other factors (*P5*). One such examined factor is risk propensity, although it is found to have a limited (Huff & Prybutok, 2008) or insignificant (Keil et al., 2000) impact. Other factors discussed include the costs of risk responses and the politics around them (Bannerman, 2008).

3.3 On the Creation of Dialectical Forces

The above delineation effort recognizes several divergences between the two bodies of knowledge that thus create two dialectical forces. First, in terms of construct definitions, the normative and experiential bodies of knowledge differ on what constitutes risk and risk response. For example, while the normative risk exposure construct has a specific two-dimensional definition, risk perception captures a broader range of dimensions. Second, in terms of theoretical models of how risks should be assessed and responded to, the two bodies of knowledge differ significantly. For example, experiential knowledge considers disengaging from the normative prescriptions on the risk management process as a rational decision (Kutsch & Hall, 2009). Apparently, there are some tensions about which behavior is more conducive to proper risk management and, thus, increased project performance. These tensions deserve to be better identified and addressed, considering that (1) IT projects have a high failure rate largely due to unmanaged risks (Bloch, Blumberg, & Laartz, 2012; Charette & Romero, 2015; Flyvbjerg & Budzier, 2011); (2) risk management prescriptions in research can be disseminated to ITPMs (Mignerat & Rivard, 2012); (3) the existence of these tensions, given the possible wisdom in both bodies of knowledge, makes choosing only one of them for developing prescriptions a frail decision (Baskerville & Stage, 1996); and (4) to date, clear guidelines on how to address the tensions by reconciling the two knowledge bases is lacking. Therefore, in the next section we will contrast the two bodies of knowledge to find a core dialectical tension; and, in the section after that, we will attempt to reconcile that tension.

4 Contrastation Findings: What Are Some Key Conceptual Tensions Between the Two Bodies of Knowledge?

The contrastation step revealed dialectical tensions between the assumptions of the two bodies of knowledge. In particular, we found a widely discussed tension regarding the relative importance of the probability and impact dimensions of risk exposure (48 relevant excerpts in 28 papers). Whereas the normative view assumes that the probability of the undesired outcomes dimension of risk exposure is at least as important as the impact of the undesired outcomes dimension, the experiential view considers that the impact of the undesired outcomes dimension of risk exposure is more important than its probability of occurrence dimension (e.g., Bannerman, 2008; Taylor et al., 2012). We identified another key tension regarding the relative importance of various determinants to be considered for a risk response decision (161 pertinent excerpts in 42 papers). Our contrastation revealed that the normative body of knowledge—as a collective—assumes that the determinants of a successful risk response enactment decision are the level of risk exposure and the expected risk-mitigation effects of the risk response; however, the experiential body of knowledge considers that the determinants of a successful risk response enactment decision are beyond the level of risk exposure and the risk-mitigation effects of the risk response. One dialectical tension about the nature of risk assessment, however, stood out in our contrastation (199 relevant excerpts in 53 papers). Given that risk assessment is often a key basis for any risk response action, in the following we choose to focus on this salient tension to enable a deeper discussion of contrastation as well as sublation.

4.1 A Key Tension About the Nature of Risk Assessment: The Relative Performance of Intuition and Deliberate Analysis

Both normative and experiential bodies of knowledge agree that the performance of risk assessment—which refers to both effectiveness and efficiency—is important for project success. Effectiveness involves the ability of the risk assessment process to cover all significant risk sources and events (Powell & Klein, 1996), risk interrelationships (Hwang, Hsiao, Chen, & Chern, 2016), and risk timing and dynamics (Hwang et al., 2016; Ward, 1999). It also concerns the ability of the process to provide sound risk exposure estimates to prioritize the identified risk sources in the order of the response attention they need (Ward, 1999). Effective risk assessment provides an impetus for timely action before it is too late by influencing the behavior of key stakeholders (Thamhain, 2013). For example, it can motivate ITPMs to coordinate an appropriate risk response enactment or to synchronize the perceptions of those involved (de Bakker et al., 2011). Efficiency is concerned with the cost justifiability of the resources (e.g., effort) required for producing an accurate risk assessment (Kutsch and Hall, 2009), considering that project managers often lack the power to secure all the required resources (Pinto, 2000). Our contrastation revealed a conceptual tension between the two bodies of knowledge on the relative performance of intuition and deliberate analysis for risk assessment.

4.2 Normative Assumption

Most of the normative body of knowledge has prescribed that ITPMs perform a deliberate analysis of risks using the offered tools (e.g., risk archives, risk checklists, risk exposure instruments) and techniques (e.g., calculating risk exposure by conducting brainstorming sessions). Indeed, research suggests that such analysis provides a scientific anchor to risk assessment (Slovic & Peters, 2006) and is a means of focusing attention on the risk assessment exercise (Dane & Pratt, 2007). In this regard, our contrastation reveals several manifestations of how and why the normative body of knowledge considers deliberate analysis to outperform intuition.

Some manifestations concern the relative effectiveness of deliberate analysis. In *Manifestation A*, it is suggested that deliberate analysis covers a wider range of relevant risks than intuition. Analytical tools can enable organizational learning by capturing the past experiences of experts (Lyytinen & Robey, 1999). For example, specific risk repositories enable learning within organizations, and generic risk checklists (often developed through Delphi studies of experts) enable learning across organizations (e.g., Moynihan, 1997; Schmidt et al., 2001). The normative body of knowledge considers that by using such learning, more relevant risks could be identified. For example, Keil et al. (2008) conclude that the risk checklist they developed in their study helps ITPMs identify actual risks. In *Manifestation B,* using deliberate analysis is viewed as increasing the accuracy of risk estimates (Keil et al., 2000). This manifestation considers that intuition can be erroneous and that analytical approaches help ITPMs avoid cognitive biases that can lead to missing or over/underestimating risks (Gemmer, 1997; Kutsch & Maylor, 2011). In *Manifestation C*, deliberate analysis is considered to be a better motivator for risk response enactment than intuition. Deliberate analysis using techniques such as risk brainstorming sessions is viewed as enabling communicative action that can harmonize the risk perceptions of different stakeholders (de Bakker et al., 2011) and thus reduce disparities among stakeholders' perceptions (Keil et al., 2002). Accordingly, they are believed to enable a group of experts to reach a consensus and orchestrate action (Lyytinen et al., 1998). Likewise, as Drummond (1996) reports, some view intuitions as inadmissible for risk response decision-making.

The last manifestation concerns the higher efficiency of deliberate analysis. In *Manifestation D*, it is suggested that deliberate analysis reduces the required information processing efforts because it standardizes how risks are identified (e.g., using checklists) and how multiple items of information about risks are reduced into an overall evaluation (e.g., using the risk exposure formula). Such standardization helps ITPMs save effort in selecting and agreeing upon how to combine various items of information.

In formal terms:

Normative Assumption: Oftentimes, deliberate analysis outperforms intuition for risk assessment

4.3 Experiential Assumption

Our synthesis of experiential studies (capturing the experiential knowledge created by ITPMs) suggests that ITPMs often decide upon risk responses based on risk perceptions derived by intuition without the assistance of analytical risk assessment tools and techniques (Bannerman, 2008; Kutsch et al., 2013; Ropponen, 1999). Our contrastation reveals several manifestations of how and why many ITPMs (and some researchers alike) assume that intuition performs relatively better than deliberate analysis.

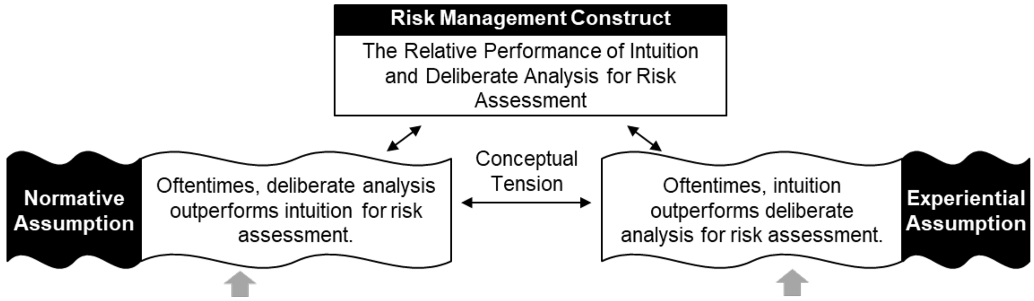
Some manifestations concern the relative effectiveness of intuition. In *Manifestation E*, it is suggested that ITPMs' intuition covers a wider range of relevant risks than risk checklists can. Risk checklists are argued to have a narrow span of attention (Lyytinen et al., 1998) and to create serious risk blind spots (Du et al., 2007; Keil et al., 2008). In *Manifestation F*, intuition is considered to provide more realistic risk estimates than deliberate analysis. While deliberate analysis tools and methods suggest a structured way of assessing risks, some ITPMs doubt whether risks can be carefully analyzed, believing that the produced risk estimates are not real (Kutsch et al., 2013). Particularly, deliberate analysis is viewed as conveying a false sense of precision, for example, by providing too precise probability estimates (Pfleeger, 2000). Moreover, intuition can see more dimensions to risk such as its timing or controllability (Pablo, 1999). In *Manifestation G*, intuition is considered to be more conducive to proper risk response enactment. Risk assessment tools and techniques sometimes have a limited impact on ITPMs' risk perceptions (Baskerville & Stage, 1996; Du et al., 2007) and response behaviors (Kutsch et al., 2013). The outputs of most risk assessment tools present risk assessment results as dry statistics—that is, in a too factual manner which lacks the affect that might be necessary for individuals to take action (Slovic & Peters, 2006). However, intuition can motivate action because it creates an affective charge referred to as "gut feel" (Akinci & Sadler-Smith, 2012, p. 116), which is potent enough to induce action (Gigerenzer, 2008). Particularly, a strong negative intuition may be experienced with visceral reactions, such as fear, anxiety, or dread (Loewenstein, Weber, Hsee, & Welch, 2001), effects that deliberate analysis is less likely to induce.

The last manifestation concerns the efficiency of intuition. In *Manifestation H*, intuition is considered to be less effortful than deliberate analysis. Intuition is heuristic driven and thus relies on mental shortcuts, such as reliance on accessible information (e.g., what happened last time) (Tversky & Kahneman, 1974) for judgment and decision-making. However, analysis can be unreasonably cumbersome. For example, for Taylor's (2005) respondents, risk management in its normative sense was costly and considered a luxury.

In formal terms:

Experiential Assumption: Oftentimes, intuition outperforms deliberate analysis for risk assessment.

Figure 7 illustrates the dialectical tension between the views on the relative performance of analytical and intuitive risk assessments. The next section proposes a model that can reconcile this tension.



ID	Manifestations of the Normative Assumption	# of Excerpts
A	Deliberate analysis covers a wider range of relevant risks than intuition.	38
B	Using deliberate analysis increases the accuracy of risk estimates.	51
C	Deliberate analysis is a better motivator for proper risk response enactment than intuition.	14
D	Deliberate analysis reduces the required information processing efforts.	61

ID	Manifestations of the Experiential Assumption	# of Excerpts
E	Intuition covers a wider range of relevant risks than deliberate analysis using normative prescriptions.	10
F	Intuition provides more realistic risk estimates than deliberate analysis using normative prescriptions.	10
G	Intuition is more conducive to proper risk response enactment than deliberate analysis using normative prescriptions.	9
H	Intuition is less effortful than deliberate analysis using normative prescriptions.	6

Figure 7. A Summary of the Dialectical Tension Between the Normative and Experiential Bodies of Knowledge on the Relative Performance of Intuition and Deliberate Analysis for Risk Assessment

5 Sublation: Reconciling the Dialectical Tension on the Relative Performance of Deliberate Analysis and Intuition

To reconcile the dialectical tension between the normative and the experiential bodies of knowledge on the relative performance of deliberate analysis and intuition, we adopt the perspective that the approaches may be complementary, implying that analytical methods can be complemented with managerial judgments (Thamhain, 2013). Therefore, rather than taking sides on either view, we sublate the views toward creating bridging knowledge. We first articulate an assumption that enables developing contingent theories that can account for both views:

Sublating Assumption: Intuition and deliberate analysis can outperform each other.

We then build on this assumption to develop a theoretical model of the contingencies that influence the relative performance of each approach (Figure 8). Drawing from the managerial decision-making literature (e.g., Dane & Pratt, 2007; Salas et al., 2010), we suggest that the three antecedent categories of project characteristics (risks' temporal complexity and risks' structural complexity), organization characteristics (project stakeholders' involvement and methods-using pressures), and ITPMs' characteristics (project-specific expertise) explain the relative performance of intuition and deliberate analysis for risk assessment. We also emphasize the role of project-specific expertise by explaining its moderating effects. The model's constructs and their definitions are listed in Table 2.

5.1 Project Characteristics

Risks' Temporal Complexity. Project temporality refers to "the transition from the starting conditions to what happens during the project to its outcomes" (Gemino et al., 2008, p. 12), which creates risks with complex temporal characteristics (Gemino et al., 2008; Hwang et al., 2016; Ward, 1999). To examine two such characteristics, we define risks' temporal complexity by the two dimensions of risk source emergence and risk event imminence. Risk source emergence refers to the extent to which the cause of an undesired outcome emerges during a project (Gemino et al., 2008). As risk values change over time, new risks can continue to emerge during a project. Risk event imminence refers to the extent to which the negative impact of a risk source on project performance is likely to materialize in a looming risk event after the risk source has emerged rather than in a distant risk event (Ward, 1999).

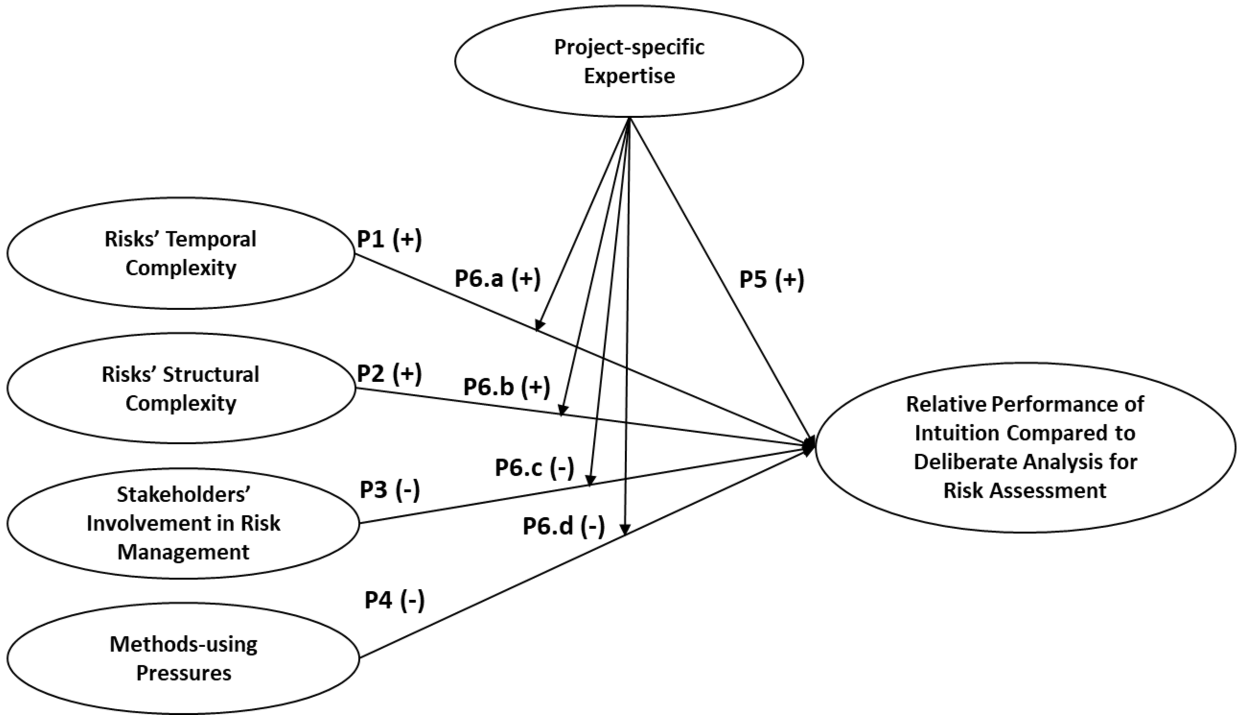


Figure 8. A Model of the Relative Performance of Intuition and Deliberate Analysis for IT Project Risk Assessment

We propose that risks' temporal complexity increases the relative effectiveness of intuition in two ways. First, risk source emergence influences the relative estimation accuracy of intuition. A priori risks are discovered early in projects (Gemino et al., 2008) when ITPMs have not yet developed a deep understanding of the project. Such unfamiliarity with the specifics of a project makes ITPMs' intuition unready for pattern recognition; thus, they may rely on generic risk checklists to understand risks (Thamhain, 2013). However, emergent risks arise when a project has progressed in time and ITPMs have developed a deeper familiarity with the project. This effect is consistent with the findings that analytical tools are used chiefly at the beginning of IT projects (Bannerman, 2008; Ropponen, 1999; Taylor, 2007). Second, risk source emergence increases the relative action impetus of intuition. Sometimes, risk responses might be effective only if they are enacted early enough (Addison & Vallabh, 2002). But emergent risks do not have a specific timeframe for arising; therefore, they require ongoing consideration unless some action can eliminate them (Ward, 1999). While intuition is continuous, deliberate analysis needs to be iterated (Baskerville & Stage, 1996)—for example, as a risk review after each project milestone. Thus, intuition is more instrumental in dealing with emergent risks. The importance of such continuous risk assessment has been emphasized in IS by highlighting the role of maintaining risk mindfulness (Kutsch et al. 2013) and situational awareness (Taylor, 2007). Similarly, when risks are identified, they may need an urgent response. This urgency creates time pressure, and intuition outperforms analysis under time pressure (Dane, Rockmann, & Pratt, 2012). Intuition quickly induces feelings of dread and stress, and thus it is instrumental when there is a need to act fast (Gigerenzer, 2008); but, with some exceptions (e.g., Ward, 1999), most deliberate analysis methods are silent about risk response urgency.

We also propose that risks' temporal complexity influences the relative efficiency of intuition. Risk source emergence increases the frequency of reapplications of tools and techniques; therefore, it makes deliberate analysis increasingly more time-consuming. Intuition, however, is quite automatic, no matter how many times it is used. Therefore, emergent risks make intuition relatively more efficient. Moreover, risk event imminence increases the time pressure; as time becomes a more precious commodity, deliberate analysis becomes costlier and less justified than intuition. Indeed, researchers suggests that time pressure motivates individuals to rely more on intuition than on deliberate analysis (Salas et al. 2010).

Table 2. Construct Definitions

Construct	Definition	Dimensions	Definition	Relevant studies
Relative performance of intuition compared to deliberate analysis	The difference between the performance of intuition and deliberate analysis for risk assessment in IT projects.	Relative risk coverage	The extent to which one risk assessment process (intuition or deliberate analysis) identifies more relevant risks than the other process.	Du et al. (2007); Keil et al. (2008); Powell & Klein (1996)
		Relative estimation accuracy	The extent to which one risk assessment process (intuition or deliberate analysis) identifies more reasonable risk exposure estimates than the other process.	Kutsch & Hall (2005); Kutsch & Maylor (2011); Pfleeger (2000); Ward (1999)
		Relative action impetus	The extent to which one risk assessment process (intuition or deliberate analysis) motivates taking a timely action concerning risks better than the other process.	de Bakker et al. (2011); Kutsch & Hall (2010)
		Relative cost justifiability	The extent to which one risk assessment process (intuition or deliberate analysis) is more efficient (time, effort, and other resources) than the other process.	Kutsch & Hall (2009); Ward (1999)
Risks' temporal complexity	The extent to which risks' existence and nature fluctuate over time.	Risk source emergence	The extent to which the cause of an undesired outcome arises later in projects, versus existing earlier.	Gemino et al. (2008); Thamhain (2013);
		Risk event imminence	The time proximity between a risk source and the associated risk event(s).	Hwang et al. (2016); Ward (1999)
Risks' structural complexity	The extent to which risks are abundant and entangled in a project.	Risk abundance	The extent to which multiple risks coexist in a project.	Barki et al. (2001); Schmidt et al. (2001)
		Risk entanglement	The extent to which risks are interconnected by causing or amplifying each other.	El-Masri & Rivard (2012); Hwang et al. (2016); Thamhain (2013); Ward (1999)
Stakeholders' involvement in risk management	The extent to which various project stakeholders participate in risk assessment and risk response planning.	Informational involvement	The extent to which ITPMs need to inform other project stakeholders of particular risks.	de Bakker et al. (2011); Thamhain (2013)
		Behavioral engagement	The extent to which ITPMs need to collaborate with other stakeholders in deciding about and committing to risk responses.	de Bakker et al. (2011); Kutsch & Hall (2010); Thamhain (2013)
Methods-using pressures	The extent to which credible sources of pressure expect the application (or nonapplication) of deliberate risk assessment practices.	Direct pressures (injunctive)	The extent to which using a specific analytical tool or technique is mandated.	Mignerat & Rivard (2012)
		Indirect pressures (descriptive)	The extent to which risk management is routinized in the environment surrounding an ITPM.	Kutsch et al. (2013)
Project-specific expertise	The extent to which an ITPM has developed a deep and rich knowledge base from extensive experience with managing similar IT projects.	Experience	The extent to which an ITPM has gained practical contact with similar IT projects, including the number of years of managing such projects and the number of projects.	Huff & Prybutok (2008)
		Training	The extent to which an ITPM has received training—formal or informal—related to managing similar projects.	Huff & Prybutok (2008)

Proposition 1: Risks' temporal complexity positively influences the relative performance of intuition compared to deliberate analysis for risk assessment.

Risks' Structural Complexity. Another aspect of complexity in projects is the number of structural elements and their interactions (Thamhain, 2013; Whitty & Maylor, 2009). Building on this, we define project risks' complexity as the extent to which risks are abundant and entangled in a project. Risk abundance refers to the extent to which multiple risks coexist in a project. Indeed, IT projects can involve various risks such as new technologies, large application size, lack of team expertise, application complexity, and uncertainty about requirements (Barki et al., 2001). Risk entanglement refers to the extent to which risks are intertwined by causing or amplifying each other (El-Masri and Rivard, 2012; Hwang et al., 2016; Thamhain, 2013; Ward, 1999). Together, risk abundance and risk entanglement can create compounding outcomes, with risks exhibiting cascading and/or nonlinear effects. For example, few small unattended risks can create a domino effect (Hwang et al., 2016; Thamhain, 2013). Risks' structural complexity varies across projects. For example, while it might be low in a small IT infrastructure project, it could be strong in large projects (Charette, 2005).

We propose that project risks' structural complexity increases the relative estimation accuracy of intuition. First, low risk abundance and entanglement mean that the structure of the problem can be easily decomposed (e.g., using a root cause analysis, or by defining one impact and one probability value instead of a distribution for each) so that each piece can be analytically evaluated. A typical deliberate analysis can be performed under such situations. However, high complexity means an increased number of informational items are processed in an unstructured way. Deliberate analysis involves controlled reasoning and comprehensive logic (Kahneman & Frederick, 2005) in which the problem is decomposed into multiple evaluable pieces (so that one can name the analytical steps taken to produce the results) and, as such, cannot easily handle complex and dynamic situations. While analytical methods that can reasonably deal with high complexity are rare (Hwang et al., 2016), intuition can simultaneously handle multiple informative items (Dane & Pratt, 2007) in an indecomposable context (Dane et al., 2012; Salas et al., 2010) since it uses heuristics processing (Kahneman & Frederick, 2005). Second, low risk entanglement means less dynamic effects, and the analytical results will remain valid for some time. However, risks' structural complexity can create high temporal complexity, and, as proposed above, intuition outperforms deliberate analysis for highly temporal risks. In the same vein, researchers suggest that while most analytical approaches are created using the normative body of knowledge (Lyytinen et al., 1996), simple heuristics might perform better under high uncertainty (Volz & Gigerenzer, 2012). Likewise, IS researchers argue that relying on experience is more advantageous in the context of complex and ill-structured tasks (Huff & Prybutok, 2008).

We also posit that project risks' complexity increases the relative efficiency of intuition. When project risks are complex, analyzing all the informational items that interact and change dynamically can become an increasingly cumbersome task because it requires processing too many information cues (Dane et al., 2012) which could lead to a state colloquially known as "paralysis by analysis". Intuition, however, can continue to process multiple informational items in complex problem spaces rapidly and effortlessly (Kahneman & Frederick, 2005).

Proposition 2: Risks' structural complexity has a positive effect on the relative performance of intuition compared to deliberate analysis for risk assessment.

5.2 Organizational Characteristics

Stakeholders' Involvement in Risk Management. We define stakeholders' involvement in risk management as the extent to which various project stakeholders participate in risk assessment and risk response planning. Such involvement has two dimensions of informational and/or behavioral engagement. Informational involvement refers to the extent to which ITPMs need to inform other project stakeholders of particular risks. While communications with stakeholders are an integral part of a project manager's function (PMI, 2013), the extent varies according to context. Sometimes ITPMs need to share information about risks with others, for example, to ensure that all team members' actions are aligned (Gemmer, 1997). Yet, at other times, ITPMs opt for deliberate risk denial—i.e., the refusal to reveal risk information that could have a negative connotation (Kutsch & Hall, 2005)—because speaking about risks can create unnecessary anxiety among stakeholders (Kutsch & Hall, 2005). Behavioral involvement refers to the extent to which ITPMs need to collaborate with other stakeholders in deciding about and committing to risk responses. It comprises but surpasses informational involvement. Behavioral involvement is low when risk responses are within the control of ITPMs or when stakeholders refrain from responding unless risk actually materializes (Kutsch & Hall, 2010) rather than proactively managing risks. However, behavioral involvement is strong, for example, when ITPMs need the explicit support and authorization of top management (Kutsch et al., 2013; Whittaker, 1999), when the requisite resources for risk response must be provided by other stakeholders (e.g., peer managers), and when risk response can change the fate of (troubled) projects (Taylor, 2007).

We postulate that stakeholders' involvement decreases the relative action impetus of intuition. First, when informational involvement is low, risk communication is not a concern, and intuition suffices. However, when informational involvement is strong, convincing communications are required to leave no doubt about risk estimates' credibility (Gemmer, 1997; Kutsch & Hall, 2010), and thus deliberate analysis outperforms intuition. Intuition is hard to communicate to others because it is often nonconscious and creates the impression of knowing about something but not about why this knowledge exists (Salas et al., 2010). In contrast, deliberate analysis provides a shared language to communicate about risks with stakeholders (de Bakker et al., 2011). Similarly, IS research has shown that a common belief is that decisions made using deliberate analysis can be defended even when they are wrong, while intuition is quasi-unjustifiable even when it would lead to the right decision (Drummond, 1996). Second, when behavioral involvement is low, ITPMs personally lead risk response enactment without the need to collaborate with many others. However, when behavioral involvement is strong, ITPMs need to credibly communicate not only that risks are pertinent but also that certain risk mitigations should be enacted (Kutsch & Hall, 2005); otherwise, stakeholders are likely to withhold cooperation (Kutsch & Hall, 2010). Given the low relative impetus of intuition when risk management is collaborative, it is common for people to do analyses to defend their intuition, especially when they are legally responsible for the decision (Gigerenzer, 2007). In this regard, Baskerville and Stage (1996, p. 484) suggest: "The probability arithmetic [used for a normative risk assessment] is the language for expressing a subjective, but well-founded, professional opinion".

Proposition 3: Project stakeholders' involvement has a negative effect on the relative performance of intuition compared to deliberate analysis for risk assessment.

Methods-using Pressures. Methods-using pressures refer to credible pressures from key stakeholders to apply deliberate, often formal, risk assessment practices, especially when deciding upon risk response enactment. Methods-using pressures can be direct or indirect. Direct (i.e., injunctive) pressures refer to the extent to which using a specific analytical tool (e.g., software) or technique (e.g., brainstorming sessions) is mandated. For example, some stakeholders (e.g., upper management or the project management office) might expect ITPMs to perform formal risk assessment and enforce this through control and governance mechanisms to arrive at higher levels of risk management maturity or in response to environmental pressures such as the Sarbanes-Oxley Act (Mignerat & Rivard, 2012). Indirect pressures refer to the organizational routines of risk management (Kutsch et al., 2013) or risk management best practices (e.g., in PMI's PMBoK, 2013). Such pressures usually stem from the norms that have been created by institutionalized risk management practices (Mignerat & Rivard, 2012).

We propose that methods-using pressures decrease the relative action impetus of intuition. When methods-using pressures are weak, ITPMs are not concerned with complying with any specific risk assessment norms; therefore, intuitions are strong enough to motivate (or prevent) risk response enactment. However, when such pressures are strong, ITPMs are likely to try to satisfy key project stakeholders' requests especially for a sensitive function such as risk assessment. Indeed, ITPMs are found to believe that "in order to be recognised and accepted by customers and other stakeholders, there was an expectation and pressure to conform to the prescribed routine of risk management" (Kutsch et al., 2013, p. 7). In a similar vein, the decision-making literature suggests that the use of intuition decreases when people are instructed to use the provided criteria for decision-making (Dane et al., 2012).

Proposition 4: Methods-using pressures have a negative effect on the relative performance of intuition compared to deliberate analysis for risk assessment.

5.3 ITPMs' Characteristics

Project-specific Expertise. The model emphasizes the role of an ITPM's characteristics—in particular, project-specific expertise—in influencing the relative performance of intuition over deliberate analysis, both directly and as a moderator of the influence of the other antecedents.

Building on the notion of expertise-based intuition (Salas et al., 2010), we define project-specific expertise as the extent to which an ITPM has developed a deep and rich knowledge base from extensive experience in managing similar IT projects. ITPMs vary in their project-specific expertise based on their experience in managing similar projects (Huff & Prybutok, 2008) and the training they receive in the technical (domain knowledge) and managerial aspects of such projects (e.g., formal training on agile software development).

Understanding the relationship between project-specific expertise and the performance of intuition requires the knowledge of how intuition works. Intuition uses pattern recognition—i.e., one estimates the outcome of a current situation by identifying and inferring from similar cases in the past. First, one must possess a rich subjective sample of cause-effects. Second, one must possess and use heuristics, defined as mental shortcuts for information storage and retrieval (Tversky & Kahneman, 1974). Heuristics work through attribute-substitution, whereby one answers a difficult question using an accessible answer to a related but easier question. Here accessibility refers to "the ease (or effort) with which particular mental contents come to mind" (Kahneman & Frederick, 2005, p. 271). Heuristics are of several kinds, and their effectiveness varies across contexts. In the present context, using intuition involves applying certain heuristics to an ITPM's subjective sample of what can go wrong with each IT project scenario (Huff & Prybutok, 2008; Lyytinen et al., 1998). For example, to estimate how risky a project may be, an ITPM might use the availability heuristic (Tversky & Kahneman, 1974) by referring to his or her easily-retrievable knowledge of the number of recent occurrences of similar troublesome projects.

We posit that project-specific expertise increases the relative estimation accuracy of intuition in two ways. First, low expertise involves possessing a small sample of relevant cause-effects and thus immature intuition (Salas et al., 2010). In this case, deliberate analysis (e.g., using standard risk checklists) is likely to identify a wider array of pertinent risks. However, as ITPMs become experts, they develop a richer knowledge base about what will happen in each project scenario (Huff & Prybutok, 2008). Indeed, IS researchers have found that experts are not influenced by the use of risk assessment tools because they already possess relevant knowledge of the risk sources (Du et al., 2007). Second, low project-specific expertise involves not only lacking various heuristics that could be learned through experience or formal training, but also inexperience with how to properly use the heuristics. However, experienced individuals know how to select relevant heuristics that they have accumulated through past risk encounters (Gigerenzer & Gaissmaier, 2011), especially by learning from their errors (Huff & Prybutok, 2008).

We also posit that project-specific expertise increases the relative efficiency of intuition in two ways. First, heuristics are effort-reducing strategies (Shah & Oppenheimer, 2008) because they seek accessible answers to difficult questions. With low expertise, the subjective sample is deficient; yet, high expertise increases the accessibility of answers, since several related items of information will be available in the subjective sample. Second, with low project-specific expertise, selecting and using heuristics might still be effortful. However, with repeated practice, the use of heuristics becomes subconscious, contributing to a characterizing aspect of intuition (i.e., automaticity; Dane & Pratt, 2007).

Proposition 5: Project-specific expertise has a positive impact on the relative performance of intuition compared to deliberate analysis for risk assessment.

We also posit that the effect of the other antecedents of the relative performance of intuition compared to deliberate analysis is influenced by project-specific expertise. Thus, we postulate:

Proposition 6: Project-specific expertise moderates the effect of risks' temporal complexity, risks' structural complexity, project stakeholders' involvement, and methods-using pressures on the relative performance of intuition compared to deliberate analysis for risk assessment.

More precisely, without expertise, ITPMs might not be familiar with the possible emergent risks or sense the imminence of risk events. Consequently, the pattern recognition mechanism of intuition is less likely to identify such risks, leading to a weaker relative performance of intuition than deliberate analysis. With project-specific expertise, however, intuition is sensitized to identify emerging risks, and it works more automatically.

Proposition 6a: Project-specific expertise of ITPMs moderates the positive effect of risks' temporal complexity on the relative performance of intuition compared to deliberate analysis for risk assessment.

We suggest that the impact of project risks' structural complexity on the relative performance of intuition depends on project-specific expertise. When project managers lack expertise, their intuition is immature (Salas et al., 2010), especially when they do not possess the subjective sample required to perform the pattern recognition that can deal with complex project risks in a rapid manner. However, "in practice, experienced project managers of complex and uncertain software projects may rely more on their expert knowledge and judgment than on [the] prescribed rational frameworks" (Taylor, 2007, p. 2).

Proposition 6b: Project-specific expertise of ITPMs moderates the positive effect of risks' structural complexity on the relative performance of intuition compared to deliberate analysis for risk assessment.

We further posit that the negative impact of project stakeholders' involvement on the relative performance of intuition is weakened by ITPMs' project-specific expertise. Project-specific expertise improves ITPMs' communication of their intuition in two ways. First, for a risk message to be effective, the credibility of the message source is crucial (Williams & Noyes, 2007). Having high project-specific expertise can bring such credibility to ITPMs because expertise is among the strongest correlates of project managers' perceived effectiveness ratings (Thamhain & Gemmill, 1974). Second, with high expertise, managers develop various tactics for communicating their intuition, for example, by copromoting their intuitive judgments in meetings (Constantiou, Shollo, & Vendel, 2016).

Proposition 6c: Project-specific expertise of ITPMs moderates the negative effect of project stakeholders' involvement on the relative performance of intuition compared to deliberate analysis for risk assessment.

We also posit that the negative impact of methods-using pressures on the relative performance of intuition is weakened by ITPMs' project-specific expertise. Often, project managers lack formal authority and use other bases of influence. High project-specific expertise leads to having expert power, which "refers to the ability of a project manager to get those with whom he interfaces to do what he wants them to do because they attribute greater knowledge to him or believe he is more 'qualified' to evaluate the consequences of certain projects" (Wilemon & Gemmill, 1971, p. 323). As such, with significant expertise, an ITPM can circumvent the existing power structures in an organization, and intuition does not lose its relative action impetus as much as it would for a novice ITPM.

Proposition 6d: Project-specific expertise of ITPMs moderates the negative effect of methods-using pressures on the relative performance of intuition compared to deliberate analysis for risk assessment.

6 Discussion

6.1 Implications for Research and Practice

The new bridging knowledge ensuing from the proposed theoretical model opens several avenues for future prescriptive research and has practical implications.

When intuition outperforms deliberate analysis, researchers can derive more explicit prescriptions from the experiential knowledge of ITPMs. First, teaching materials can be designed to encourage ITPMs to acknowledge their intuitions. Some ways of doing so include inviting ITPMs to pay attention to the early warning signs they notice (Thamhain, 2013); documenting intuitions before starting deliberate analysis—for example, using risk checklists (Baskerville & Stage, 1996); and not simply disregarding intuitions if the output of the tool has suggested a different estimate (Drummond, 1996). Second, ITPMs' intuition can be improved by enhancing the heuristics they use. For instance, EUT motivates the use of risk exposure to prioritize risk sources. Yet, to complement this, other heuristics such as fluency (i.e., prioritizing the most salient risk sources that come to mind) and tallying (i.e., counting the number of reasons each risk source might cause undesired events and prioritizing the risk sources with the highest count) (Gigerenzer, 2008) could be further validated and promoted when designing risk assessment techniques or training programs. Third, guidelines can be developed to help ITPMs reduce the biases of their heuristics in terms of the risk sources identified and the risk level estimated. In the design of risk assessment training programs, it could be relevant to include a learning outcome about increasing the ITPMs' self-awareness regarding the ways in which intuition can be used with reduced bias.

When deliberate analysis outperforms intuition, researchers can design interventions to encourage ITPMs to rely more on normative knowledge. Researchers can design tools that screen ITPMs based on the contingencies under which deliberate analysis outperforms intuition; and, if these conditions are met, they can encourage ITPMs to continue using the tools for risk assessment and to rely upon their output for risk response. In doing so—keeping in mind that it is essential to design interventions that correspond to managerial thinking (March & Shapira, 1987)—risk assessment tools could be designed (e.g., using better data visualization) to focus attention on important aspects of information via formatting (Williams & Noyes, 2007), which would consider the usability issues associated with risk assessment tools (Taylor et al., 2012). While this would increase the practicality of these tools, it could also contribute to modifying the managerial perspective through training ITPMs to use normative prescriptions (March & Shapira, 1987).

6.2 Limitations

Our work has some limitations. First, we have studied risk response as an individual-level decision of ITPMs. Nonetheless, risk management is, at times, seen as a collective-level activity (Lim, Sia, & Yeow, 2011); thus, future studies at that level would be fruitful. Second, to create a balanced pool of papers, we reviewed some but not all of the normative papers. Although we reached saturation in our analysis, further research could explore the other papers for additional insights. Third, as with any similar exercise, our coding process might be deemed subjective. To address this issue, we attempted to make this process as coherent as possible by discussing various manifestations of each assumption and extracting the supporting excerpts. Nevertheless, other researchers might be able to articulate additional or even different underlying assumptions, for example, by grouping the manifestations into different assumptions during the axial and selective coding steps. Finally, we have assumed risk management to be purposeful by defining risk assessment performance as an activity that contributes to project success. However, ITPMs can use risk assessment for selective reporting (Iacovou, Thompson, & Smith, 2009) or for deliberate stakeholder deception (Kutsch & Hall, 2005), which we deemed out of the scope of experiential knowledge. Future research could explore those aspects.

6.3 Contributions

Notwithstanding these limitations, our study makes several contributions. First, we provide a foundation for future bridging research on IT project risk management by offering a model that reconciles two seemingly contrasting bodies of knowledge. Second, we unearth common conceptualizations and overarching process and variance models from the normative and experiential bodies of knowledge and we provide a set of conceptual assumptions specific to each stance. By doing so, we contribute to the ongoing discussion of the assumptions underlying the IT project risk management literature (e.g., de Bakker et al., 2010). Overall, we contribute to IT project risk management research programs (e.g., Sauer et al., 2008) by calling for more incorporation of the experiential phenomena of decision-making into this stream of research. We try to stimulate interest in this relevant area by showcasing how a dialectical tension could be addressed by theorizing.

Moreover, we make a methodological contribution by offering a three-step dialectical review approach. In particular, we contribute to the research on examining assumptions (e.g., Alvesson & Sandberg, 2011; Davis, 1971) by adapting the grounded theory literature review method (Wolfswinkel et al., 2013). In doing so, we propose and showcase that the dialectical interrogation mechanism of problematization can be implemented using the coding techniques of grounded theorizing. We suggest treating the papers as data, manifestations of their assumptions as open codes close to the data, and assumptions as higher-level (axial/selective) codes.

7 Concluding Remarks

Using a theme-based review, we delineated two bodies of knowledge—normative and behavioral—within the IT project risk management literature, and we synthesized what has been learned from each. Contrastation led us to identify several dialectical tensions between the assumptions of the two bodies of knowledge on key issues such as the relative importance of the probability and impact dimensions of risk exposure and the relative importance of various determinants to be considered for a risk response decision. Given that risk assessment is often a key basis for any risk response action, one tension appeared particularly relevant—that of the relative performance of intuition compared to deliberate analysis. We addressed this tension in the sublation step of our study. To do this, we adopted one of Poole and Van de Ven’s (1989) recommendations of building upon oppositions, tensions, and contradictions by finding a new perspective that could eliminate existing oppositions. We thus developed a theoretical model of the contingencies under which each approach can perform better. The model suggests that ITPMs’ project-specific expertise, risks’ temporal complexity, risks’ structural complexity, stakeholders’ involvement in risk management, and methods-using pressures explain the relative performance of intuition and deliberate analysis for risk assessment. Moreover, the model suggests that project-specific expertise plays a key role by moderating all the other proposed effects. Given the applied nature of risk management research, we discuss several avenues for developing future prescriptive research, and we suggest testing the model as a key step in this direction.

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Appendix A: Coding Scheme for Research Objectives

Guided by our understanding of the two bodies of knowledge, and to create a manageable but balanced pool of papers, we coded the papers on the basis of their key research objective as pertaining to chiefly normative or experiential knowledge. If a paper has both objectives at the same time or the objectives cannot be separated, we coded the paper as mixed. The table below presents our coding scheme.

Table A1. Coding Scheme for Research Objectives

Body of knowledge		Normative	Experiential
Theme / focus		**Overarching questions**	**Overarching questions**
		• How to further build on and advance decision-theoretic knowledge in order to have higher chances of project success? • Are the resulting prescriptions indeed effective? Why?	• How do ITPMs actually manage project risks in practice? • Are these behaviors different from the prescriptions derived from normative knowledge? Why?
		Specific questions	**Specific questions**
Core constructs	**Risk**	How to conceptualize project risks according to the classical decision theories?	How do ITPMs conceptualize and perceive risks?
		What are the key specific risk sources and events?	What are the key risk sources and events that ITPMs see in IT projects? How do they differ from the ones in the literature?
		How should risks be assessed?	How and why do ITPMs' perceptions of risks differ from that of other entities (e.g., other stakeholders)?
	Risk response	What are the key risk responses that should be enacted to cope which each specific risk source or event?	What are the key risk responses that ITPMs actually use (or do not use) in IT projects?
		How should appropriate risk responses be selected for specific risks?	How and why are the decisions of whether or not to enact these responses different from normative prescriptions?
Research models	**Process models**	What are the key formal steps that should be taken in project risk management?	What are the steps that ITPMs actually take when managing risks?
		How and why does applying formal risk management processes influence project success?	How and why do ITPMs disengage from applying risk management practices?
	Variance models	What constitutes a risk with a negative impact on project success?	What influences ITPMs risk perceptions?
		What determines a good risk response?	What influences ITPMs risk response enactment?
		What is the impact of applying formal risk management processes on project success?	What motivates ITPMs to apply (or disengage from applying) formal risk management practices?

Appendix B: Details on the Investigated Papers

Table B1. Details on Investigated Papers

Study	Journal	Citation count (Oct. 2016)
Studies with a research objective pertaining to normative knowledge		
Barki et al. (1993)	*Journal of Management Information Systems*	811
Barki et al. (2001)	*Journal of Management Information Systems*	447
Baskerville & Stage (1996)	*MIS Quarterly*	159
Boehm (1991)	*IEEE Software*	1831
Ehie & Madsen (2005)	*Computers in Industry*	415
Fairley (1994)	*IEEE Software*	235
Gemino et al. (2008)	*Journal of Management Information Systems*	112
Han & Huang (2007)	*Journal of Systems and Software*	206
Heemstra & Kusters (1996)	*Journal of Information Technology*	89
Huang et al. (2004)	*Industrial Management & Data Systems*	243
Jiang & Klein (1999)	*Information & Management*	184
Jiang & Klein (2000)	*Journal of Systems and Software*	216
Jiang et al. (2006)	*Journal of the Association for Information Systems*	92
Keil et al. (1998)	*Communications of the ACM*	831
Lyytinen et al. (1996)	*Journal of Information Technology*	106
Mursu et al. (2003)	*European Journal of Information Systems*	57
Nidumolu (1995)	*Information Systems Research*	538
Nidumolu (1996)	*Journal of Management Information Systems*	219
Powell & Klein (1996)	*Journal of Information Technology*	61
Saarinen & Vepsäläinen (1993)	*European Journal of Information Systems*	37
Schmidt et al. (2001)	*Journal of Management Information Systems*	1092
Scott & Vessey (2002)	*Communications of the ACM*	414
Sherer & Alter (2004)	*Communications of the AIS*	123
Sumner (2000)	*Journal of Information Technology*	631
Tesch et al. (2007)	*Journal of Computer Information Systems*	125
Wallace & Keil (2004)	*Communications of the ACM*	322
Wallace et al. (2004a)	*Decision Sciences*	425
Wallace et al. (2004b)	*Information & Management*	392
Whittaker (1999)	*Information Management & Computer Security*	286
Willcocks & Margetts (1994)	*European Journal of Information Systems*	169
Yetton et al. (2000)	*Information Systems Journal*	144
Average citations of studies with a normative research objective		**355.2**
Studies with a mixed research objective		
Addison & Vallabh (2002)	Other: Conference proceedings—SAICSIT 2002	145
Armour (2005)	*Communications of the ACM*	23
Baccarini et al. (2004)	*Industrial Management & Data Systems*	229
Bannerman (2008)	*Journal of Systems and Software*	273
Bussen & Myers (1997)	*Journal of Information Technology*	106
Charette (1996b)	*IEEE Software*	112
Charette (1996a)	*Journal of Information Technology*	64
Charette (2005)	*IEEE Spectrum*	272
de Bakker et al. (2010)	*International Journal of Project Management*	213

de Bakker et al. (2011)	*Project Management Journal*	31
de Bakker et al. (2012)	*International Journal of Project Management*	36
Lyytinen & Robey (1999)	*Information Systems Journal*	438
Lyytinen et al. (1998)	*Information Systems Research*	358
McGrew & Bilotta (2000)	*Management Decision*	37
Ropponen & Lyytinen (1997)	*European Journal of Information Systems*	99
Ropponen & Lyytinen (2000)	*IEEE Transactions on Software Engineering*	396
Smith et al. (2001)	*Communications of the AIS*	48
Williams et al. (1997)	*IEEE Software*	83
Average citations of studies with a mixed research objective		**164.6**
Studies with a research objective pertaining to experiential knowledge		
Carr (1997)	*IEEE Software*	23
Drummond (1996)	*Journal of Information Technology*	88
Du et al. (2007)	*Decision Support Systems*	55
Gemmer (1997)	*IEEE Software*	76
Glass (1999)	*Communications of the ACM*	87
Huff & Prybutok (2008)	*Project Management Journal*	23
Jani (2011)	*International Journal of Project Management*	46
Keil et al. (2000)	*Journal of Systems and Software*	139
Keil et al. (2002)	*Information Systems Journal*	209
Keil et al. (2008)	*Journal of Systems and Software*	71
Kutsch & Hall (2005)	*International Journal of Project Management*	95
Kutsch & Hall (2009)	*Project Management Journal*	34
Kutsch & Hall (2010)	*International Journal of Project Management*	129
Kutsch & Maylor (2011)	*International Journal of Project Organisation and Management*	3
Kutsch et al. (2013)	*European Journal of Information Systems*	11
Kutsch et al. (2014)	*Research-Technology Management*	9
Lauer (1996)	*Journal of Information Technology*	22
Lim et al. (2011)	*Journal of the Association for Information Systems*	15
Liu et al. (2010)	*Information Systems Journal*	69
Mignerat & Rivard (2012)	*Information and Organization*	21
Moynihan (1996)	*Journal of Information Technology*	85
Moynihan (1997)	*IEEE Software*	159
Moynihan (2000)	*Journal of Systems and Software*	28
Moynihan (2002)	*Information & Management*	31
Pablo (1999)	*Journal of Managerial Psychology*	53
Pfleeger (2000)	*Journal of Systems and Software*	79
Ropponen (1999)	Other: Book chapter	25
Taylor (2005)	*International Journal of Project Management*	27
Taylor (2006)	*Project Management Journal*	36
Taylor (2007)	Other: Conference Proceedings—ICIS 2007	5
Taylor et al. (2012)	*Journal of Information Technology*	33
Average citations of studies with an experiential research objective		**57.6**

Appendix C: Synthesis of the Normative and Experiential Bodies of Knowledge

Here we provide more details on our synthesis of the process and variance theories from the normative and experiential knowledge bases.

Table C1. Normative Knowledge: The Formal Risk Management Process

Study	Risk assessment			Risk control			S7: Process iteration
	S1: Risk identification	S2: Risk analysis	S3: Risk prioritization	S4: Risk response planning	S5: Risk response enactment	S6:Risk monitoring	
Addison & Vallabh (2002)	*X*	*X*		*X*			*X*
Baccarini et al. (2004)	*X*	*X*		*X*		*X*	
Bannerman (2008)	*X*	*X*		*X*		*X*	*X*
Baskerville & Stage (1996)	*X*	*X*	*X*	*X*			*X*
Boehm (1991)	*X*	*X*	*X*	*X*		*X*	*X*
Charette (1996a)	*X*	*X*		*X*	*X*	*X*	*X*
de Bakker et al. (2010)	*X*	*X*	*X*	*X*		*X*	*X*
de Bakker et al. (2011)	*X*	*X*		*X*	*X*	*X*	*X*
de Bakker et al. (2012)	*X*	*X*		*X*			
Du et al. (2007)	*X*			*X*			
Fairley (1994)	*X*	*X*		*X*		*X*	*X*
Heemstra & Kusters (1996)	*X*	*X*	*X*	*X*			*X*
Jani (2011)	*X*	*X*					
Keil et al. (2008)	*X*			*X*			
Kutsch & Hall (2009)	*X*	*X*		*X*		*X*	
Kutsch et al. (2014)	*X*	*X*	*X*	*X*			
Lim et al. (2011)	*X*	*X*		*X*			*X*
Lyytinen et al. (1998)	*X*	*X*		*X*			*X*
Mignerat and Rivard (2012)	*X*	*X*	*X*			*X*	
Powell & Klein (1996)	*X*	*X*					
Ropponen (1999)	*X*	*X*		*X*			
Smith et al. (2001)	*X*	*X*		*X*			*X*
Taylor (2007)	*X*	*X*	*X*	*X*			
Tesch et al. (2007)	*X*	*X*		*X*		*X*	
Williams et al. (1997)	*X*	*X*	*X*	*X*		*X*	*X*

Table C1 highlights the most pronounced risk management steps in the reviewed studies. Other steps not included in this table but mentioned by a few studies are:

- a risk management planning (initiation) step mentioned by Baccarini et al. (2004), de Bakker et al. (2012), Kutsch and Hall (2009), and Tesch et al. (2007);
- a risk categorization step after risk identification as proposed by Jani (2011) and Powell and Klein (1996);
- a contingency planning step (separate from risk response planning) as discussed by Bannerman (2008) and Fairley (1994);
- a crisis management step suggested by Fairley (1994); and
- a separate risk communication and reporting step as recommended by Baccarini et al. (2004), Bannerman (2008), Boehm (1991), de Bakker et al. (2011), de Bakker et al. (2012), and Kutsch and Hall (2005).

Table C2. Normative Knowledge: Variance Studies

Relationship		Study	Quantitative/ Qualitative/ Conceptual	Quant. findings	Comment
R1	Risk → Project performance: Direct effect	Charette (2005)	Conceptual	-	Unmanaged risks lead to project failure.
		Ehie & Madsen (2005)	Quantitative	Mixed	"There was a strong correlation between successfully implementing ERP and six out of the eight factors identified" (p. 545).
		Gemino et al. (2008)	Quantitative	Mixed	Emergent risk factors influence only the project process performance, not the product performance.
		Han & Huang (2007)	Quantitative	Mixed	Different risk factors influence high, medium, and low-performance software projects
		Jiang & Klein (1999)	Quantitative	Mixed	"the various project risk variables are not equally important in influencing system success" (p. 268)
		Jiang & Klein (2000)	Quantitative	Mixed	Some specific risks had an effect, but "The remaining risk factors did not relate to the overall measure of effectiveness" (p. 7).
		Nidumolu (1996)	Quantitative	Mixed	See p. 99. The effect of requirement uncertainty on performance (process) is significant but on performance (product) is insignificant.
	Risk → Project performance: Mediated effect through intermediary risks	Gemino et al. (2008)	Quantitative	Mixed	"emergent risk factors cannot be, or are not currently, completely mitigated by project management practice" (p. 32) [partial mediation]
		Jiang et al. (2006)	Quantitative	Supported	"(Residual performance risk) [was included] as an intermediate variable that was significantly related with project performance" (p. 81).
		Nidumolu (1995)	Quantitative	Supported	"project uncertainty increased residual performance risk and reduced project performance" (p. 209)
		Nidumolu (1996)	Quantitative	Supported	See p. 102. The effect of requirements uncertainty on software performance risk is significant.
		Bannerman (2008)	Conceptual	-	See p. 2120. The influence of risk is mediated through vulnerabilities of the organization.
		Wallace et al. (2004a)	Quantitative	Supported	See p. 304. Project management risk mediates social subsystem risk but not technical subsystem risk.
R2	Fit → Project Performance	Barki et al. (2001)	Quantitative	Supported	Supported.
R3	Risk responses → Project performance: Contingent effect	Barki et al. (2001)	Quantitative	Supported	"deviations from an ideal Risk Management Profile were negatively correlated with Performance" (p. 54)
	Risk responses → Project performance: Direct effect	Gemino et al. (2008)	Quantitative	Supported	"project management practices are significantly directly related to process and product performance" (p. 34)
		Jiang et al. (2006)	Quantitative	Supported	"partnering significantly relates to higher user support, less residual risk" (p. 68)
		Nidumolu (1995)	Quantitative	Supported	"higher levels of both vertical and horizontal coordination lead to higher levels of overall performance" (p. 191)

Table C2. Normative Knowledge: Variance Studies

		Nidumolu (1996)	Quantitative	Mixed	The effect of vertical coordination on performance is insignificant, but that of horizontal coordination is significant.
R4	Risk responses → Project performance: Mediate via residual risks	Jiang et al. (2006)	Quantitative	Supported	"partnering significantly relates to higher user support, less residual risk, and better project performance" (p. 68)
		Nidumolu (1995)	Quantitative	Supported	"vertical coordination reduced residual performance risk, both directly and by reducing project uncertainty; consequently, it also significantly increased project performance, albeit indirectly" (p. 209)
	Risk responses → Residual risk	Ropponen & Lyytinen (1997)	Quantitative	Mixed	"little support was found for the claim that specific risk management methods are instrumental in attacking specific software risks" (p. 41)
		Addison & Vallabh (2002)	Quantitative	Mixed	"seven of the ten risk factors are reduced by the use of controls" (p. 139)
R5	Residual risk → Project performance	Jiang et al. (2006)	Quantitative	Supported	Supported.
		Nidumolu (1995)	Quantitative	Supported	H3 is supported.
		Nidumolu (1996)	Quantitative	Mixed	The effect of risk on performance (process) is significant but on performance (product) is insignificant.
R6	Formal risk management → Project performance: Indirect effect via residual risk	Ropponen & Lyytinen (2000)	Quantitative	Mixed	"general use of risk management methods" mitigates "requirements management risk" (p. 103); "those who applied risk management methods continuously managed scheduling and timing risks significantly better" (p. 103)
	Formal risk management →Project performance: Direct effect from the entire process	Ropponen & Lyytinen (1997)	Quantitative	Supported	"Our findings support in general the claim that the use of risk management methods improves system development performance" (p. 41).
		Boehm (1991)	Conceptual	-	-
	Formal risk management →Project performance: Direct effect from different steps (e.g., risk identification)	de Bakker et al. (2012)	Qualitative	-	"Risk identification and risk allocation are considered by stakeholders as contributing most often to project success…. Other risk management activities contribute less often to project success…except for risk management planning" (p. 451).
		McGrew & Bilotta (2000)	Quantitative	Supported	In two projects, the "percent correct" of risk assessment and risk intervention is consistently more than 50%.
		de Bakker et al. (2011)	Qualitative	-	"Analysis demonstrates stakeholders deliberately use risk management to convey messages to others…. Stakeholders perceive these effects as contributing to project success" (p. 75).
		de Bakker et al. (2012)	Qualitative	-	"in addition to the instrumental effects of risk management, being direct risk mitigating actions by stakeholders, individual risk management activities are able to generate communicative effects" (p. 444)

Table C2. Normative Knowledge: Variance Studies

		Baskerville & Stage (1996)	Qualitative	-	"the risk analysis technique succeeds as a helpful management tool, even though the project outcome may be failure" (p. 497)
	Formal risk management → Project performance: Mediated by way of application	Williams et al. (1997)	Conceptual	-	The paper discusses the effective vs. ineffective ways to implement risks.
		Gemmer (1997)	Conceptual	-	The paper discusses functional vs. dysfunctional risk management behaviors.
	Formal risk management → Project performance: Moderated effect	Ropponen & Lyytinen (1997)	Quantitative	Supported	"risk management performance depends on several environmental contingencies. These include the size of the IS department, the project size, project management training, project managers' experience, and the use of system development methods" (p. 46)

Table C3. Experiential Knowledge: Process Studies (Evidencing Risk Management Process Disengagement)

Process disengagement stage		Study	Statistical/ Qualitative/ Conceptual	Finding
D0	From applying the risk management process	Ropponen (1999)	Quantitative	"a large majority of project managers (62 observations = 75%) did not follow any detailed risk management approach" (p. 254)
		Fairly (1994)	Conceptual	"risk management is seldom applied as an explicit project-management activity" (p. 57)
		Bannerman (2008)	Quantitative	"Formal risk management was practiced in five projects (29%), no risk management was practiced at all in another five (29%), while the remaining seven projects (41%) adopted a range of semi-formal or informal practices" (p. 2124).
	From a purposeful application (rather than for seeking legitimacy)	Kutsch & Hall (2009)	Quantitative	"In over half of all cases, a PMI risk management process was used…. However, in one-third of the 102 cases, no formal project risk management approach was applied" (p. 78).
		Mignerat & Rivard (2012)	Conceptual	"three groups of practices—formal control, external integration and project risk management—have reached full institutionalization" (p. 126)
D1	From risk identification	Ropponen (1999).	Quantitative	"75% of the respondents used checklists" but only 33% used often (p. 254).
D2	From risk analysis	Ropponen (1999)	Quantitative	See p. 254. Risk exposure was used by 20% of ITPMs, but only 5% used often.
		de Bakker et al. (2012)	Qualitative	"Risk analysis was done in five of the seven projects" (p. 449).
		Baccarini et al. (2004)	Conceptual	"the OTR Group (1992) found that only 30 per cent of organisations applied risk analysis in their IT investment and project management processes" (p. 286)
		Bannerman (2008)	Qualitative	"No agency reported using quantitative risk assessment" (p. 2125).
		Armour (2005)	Conceptual	"many organizations…do not do an explicit risk calculation" (p. 19)
		Taylor (2005)	Qualitative	"none of the respondents carried out any quantitative assessments" (p. 441)
		Kutsch et al. (2013)	Qualitative	See p. 5.
D3	From risk prioritization	Bannerman (2008)	Qualitative	Respondents "were quite equivocal about how well the risks were prioritized" (p. 2124).
D4	From risk response planning	Kutsch & Hall 2005	Qualitative	ITPMs might not enact responses to risks because of some intervening conditions including denying uncertainty, avoiding uncertainty, delaying uncertainty, and ignoring uncertainty.
		Kutsch & Hall 2010	Qualitative	ITPMs might chose to deliberately ignore risks rather than enacting responses to them.
		Kutsch et al. (2014)	Quantitative	"28 percent (44 risks) of the risks that made it through the earlier stages were not actively managed, even though managers had already invested effort in identifying and assessing them" (p. 28).
		de Bakker et al. (2012)	Quantitative	"Risk control is mentioned in six cases [out of seven]" (p. 449).

Table C3. Experiential Knowledge: Process Studies (Evidencing Risk Management Process Disengagement)

D5	From risk response enactment	Taylor (2005)	Qualitative	"The hand-over from pre-sales to implementation teams was often a weak link, with project managers failing to follow-up risk management plans prepared at pre-sales stage" (p. 437).
D6	From risk monitoring	Taylor (2005)	Qualitative	"Respondents did not appear to use the pre-sales risk assessment to warn them about specific potential problems that they should watch out for" (p. 441).
D7	From iterating the process over the course of the project	Bannerman (2008)	Qualitative	"project management practices tended to wane as the project progressed" (p. 2124); "risk management practice was often not sustained throughout the whole project" (p. 2131)
		Taylor (2005)	Qualitative	"Many of the respondents did not regard risk assessment as an on-going project activity" (p. 442).
		Carr (1997)	Conceptual	"for the most part risk identification and analysis is performed on an ad hoc basis, generally at the beginning of the project" (p. 24)
		de Bakker et al. (2010)	Conceptual	"the sequence of identification, analysis, responses, and monitoring is often not followed" (p. 500)
		de Bakker et al. (2011)	Qualitative	"Project 2 did not follow the sequence of risk management practices" (p. 82).
S1	Deliberate risk ignorance	Kutsch & Hall (2005)	Qualitative	-
		Kutsch & Hall (2010)	Qualitative	-
		Kutsch et al. (2013)	Qualitative	-
S2	Intuitive risk management	Baskerville & Stage (1996)	Qualitative	-
		Drummond (1996)	Qualitative	-
		Ropponen (1999)	Quantitative	-

Table C4. Experiential Knowledge: Variance Studies

Relationship		Study	Quantitative/ Qualitative/ Conceptual	Quant. findings	Comment
P1	Risk checklists → Risk perception in terms of covered risks	Lyytinen et al. (1998)	Conceptual	-	Four different checklists shape ITPMs' attention to differing risk factors.
		Du et al. (2007)	Quantitative	Mixed	Dual effects: Risk checklists helped novice ITPMs identify some risks but blinded them to other risks.
	Risk checklists → Risk perception in terms of risk extent	Keil et al. (2008)	Quantitative	Supported	"the risk checklist helped subjects identify more risks than they would identify without the aid of a checklist" (p. 908)
		Du et al. (2007)	Quantitative	Supported	A significant but very small effect: "the effect of the risk assessment tool on risk perception...was small" (p. 277).
		Du et al. (2007)	Quantitative	No Support	"risk perceptions for experts were not influenced by use of the tool" (p. 279)
	Provided risk information → Risk perception	Keil et al. (2000)	Quantitative	Supported	Two provided information items are on the probability and magnitude of impact of risks.
P2	Risk propensity → Risk perception	Du et al. (2007)	Quantitative	Supported	See p. 276.
		Keil et al. (2008)	Quantitative	No support	"Contrary to our hypothesis, subjects who identified more risks were no more risk-averse than the subjects who identified fewer risks" (p. 914).
		Keil et al. (2000)	Quantitative	No support	See p. 151.
	Expertise → Risk perception	Du et al. (2007)	Quantitative	Mixed	See p. 277 (novices vs. experts).
	Role → Risk perception	Keil et al. (2008)	Quantitative	No support	See p. 913 (Inside ITPMs vs. outside consultants).
		Keil et al. (2002)	Quantitative	Supported	ITPMs vs. users.
	Self-efficacy → Risk perception	Jani (2011)	Quantitative	Supported	Task-specific self-efficacy (-)
	Cultural differences → Risk perception in terms of covered risks	Ropponen (1999)	Quantitative	Supported	-
		Liu et al. (2010)	Quantitative	Supported	-
		Mursu et al. (2003)	Quantitative	Supported	"When we compare the ranked list of factors in Nigeria with the earlier ranked lists of factors, some important differences emerge" (p. 187)
	Perceived control → Risk perception	Jani (2011)	Quantitative	Supported	Perceived control over risks - Exogenous risk (+) or endogenous risk (-)
		Schmidt et al. 2001	Quantitative	Supported	In terms of risk factor rankings, they find that "Perceived level of control relates clearly with cultural differences in individualism, power distance, and uncertainty avoidance" (p. 24).
		Du et al. (2007)	Quantitative	Supported	See p. 278 (perceived control over project—internal vs. outsourced project)
P3	Risk perception → Risk response	Jani (2011,)	Quantitative	Supported	See p. 940.
		Keil et al. (2000)	Quantitative	Mixed	See p. 151.

Table C4. Experiential Knowledge: Variance Studies

		Du et al. (2007)	Quantitative	No S=support	"Surprisingly, however, the difference in risk perception does not translate into differences in subsequent decisions on how to continue a project" (p. 280).
		Drummond (1996)	Qualitative	-	The project was simply continued despite significant risks.
P4	Risk checklists → Risk response: In terms of response type	Lyytinen et al. (1998)	Conceptual	-	Four different checklists shape ITPMs' attention to differing risk responses.
	Risk checklists → Risk response: In terms of response enactment	Du et al. (2007)	Quantitative	Supported	"the effect of the risk assessment tool on...decision-making behavior was small" (p. 277)
		Du et al. (2007)	Quantitative	Mixed	"the effect of the risk assessment tool on decision-making behavior was significant for novices, but not for experts" (p. 277)
P5	Risk propensity → Risk response	Du et al. (2007)	Quantitative	Supported	See p. 276.
		Huff & Prybutok (2008)	Quantitative	Mixed	See p. 40 (Supported for two scenarios and not supported for one scenario).
		Jani (2011)	Quantitative	Mixed	-
		Keil et al. (2000)	Quantitative	No Support	See p. 151.
	Problem context → Risk response	Lauer (1996)	Quantitative	Supported	Gain or loss context
	Reference point → Risk response	Lauer (1996)	Quantitative	Supported	Initial project endowment
	Problem framing → Risk response	Lauer (1996)	Quantitative	Supported	Different representations of the same problem
	Expertise/ Experience → Risk response	Du et al. (2007)	Quantitative	No Support	See p. 277 (expertise: novice vs. expert).
		Huff & Prybutok (2008)	Quantitative	Mixed	See p. 39 (Task-specific experience—supported for two scenarios, not supported at 5% level for one scenario).
		Huff & Prybutok (2008)	Quantitative	No support	See p. 39 (total work experience).
	Role → Risk response	Keil et al. (2008)	Quantitative	No support	See p. 913 (inside project manager vs. outside consultant).
	Perceived control over project → Risk response	Du et al. (2007)	Quantitative	Supported	See p. 277 (internal vs. outsourced projects).

Appendix D: Initial Codes

As the first step in identifying key assumptions, the initial codes were identified by searching for the terms "assume", "assumption", and "premise" in the pool of papers, reading the papers that discuss these assumptions, and converting relevant excerpts to initial open codes before creating the manifestations. This process was guided by a knowledge of influential papers on risk management assumptions outside the IS domain (e.g., March & Shapira, 1987).

Table D1. Initial Codes

Initial code	Relevant final manifestation
"IT project managers focus on a few factors and largely ignore others" (Taylor et al., 2012, p. 19).	A
"Expected utility theory (EUT)…provides the fundamental assumptions that underline project risk management: …perfect information about all of the relevant variables in terms of both quantity and quality; …perfect knowledge of the future consequences of each possible solution and their implications for the project" (Kutsch & Hall, 2009, pp. 73-74).	A
"The premise behind risk management within the context of IT-project management is that…it is feasible to identify problems before they occur" (Heemstra & Kusters, 1996, p. 333).	A/not used
"It is assumed that specific risks to a project can be identified, and that their probability and impact can be quantified" (Taylor et al., 2012, p. 19).	B
"The assumption is that risk assessment tools will provide managers with more accurate perceptions of risk, thereby allowing them to make better informed decisions and ensuring more successful outcomes" (Du et al., 2007, pp. 269-270).	A, B
"The underpinning assumption is that projects are comparable in the sense that information about risks can be generalised and is used in future projects" (de Bakker et al., 2010, p. 494).	A, B
"the assumption that the use of such devices will lead to more accurate risk perceptions that will, in turn, lead to more appropriate decisions regarding project initiation and continuation" (Keil et al., 2000, p. 145)	B, C
"The evaluation approach assumes that known risk factors are used in the current project, contributing to the management of the project and as a result to positive project outcomes" (de Bakker et al., 2010, p. 495).	C
"The recommendations also assume that project managers will, indeed, evaluate the probability and impact of each risk in order to develop a risk management plan" (Taylor et al., 2012, p. 19).	B, C
"in practice, the likelihood of outcomes and their impacts tend to enter into managers' calculations of risk independently, rather than as their products" (Bannerman, 2008, p. 2119)	F, H
"They [ITPMs] also tend to prefer verbal characterizations of risk than probabilistic representations because they are skeptical that the broad dimensionality of risk can be reduced to a single number" (Bannerman, 2008, p. 2119).	F, H
"though quantities may be involved in assessing the level of risk, there is little desire to reduce risk to a single construct of outcomes" (Lyytinen et al., 1998, p. 235)	F, H
"managers follow a less precise calculus" (Lyytinen et al., 1998, p. 235)	F, H
"Managers see risk in less precise ways" (Bannerman, 2008, p. 2119).	F, H
"it is very difficult in practice to estimate the probability of impact of many risk factors, especially in software projects" (Bannerman, 2008, p. 2119)	F, H
"managers neither understand, nor care to use precise probability estimates: crude characterizations are used to exclude certain possibilities from the decision" (Lyytinen et al., 1998, p. 235)	F, G
"many of the risks in IT projects are not aleatoric in nature (they are not based on probability), but epistemic, which means that there is not enough information available to take a decision" (de Bakker et al., 2010, p. 500)	G

Appendix E: Manifestations of the Assumptions

Initial codes (see Appendix D) were purified and used as part of open coding; but when they did not fit the data, we created new open codes to stay close to the data. The open codes were later grouped into what we call “manifestations”, and these manifestations were then abstracted to create the assumptions in a bottom-up fashion. The tables below list these manifestations for each—normative and experiential—assumption and provide some explanations and examples from the literature.

Table E1. Manifestations of the Normative Assumption

Manifestation	Explanation and example
A: Deliberate analysis covers a wider range of relevant risks than intuition.	In applying the classical decision theories such as expected utility theory (EUT), the normative body of knowledge builds on the notion of bounded rationality which suggests that “the actor has only incomplete information” (Simon, 1972, p. 163). As March (1978) notes, researchers have responded to bounded rationality by developing knowledge bases that store information from past experiences to create an intelligence that informs future decision-making. We extracted 13 excerpts (from 11 papers) that have explicitly mentioned storing and retrieving risk information using such knowledge bases as a way of identifying more risks. For example, Wallace et al. (2004a, p. 307), discussing the instrument they developed, suggest that “practitioners can use the instrument to develop historical databases of the risks associated with different projects and their outcome. Compilation of this information could provide a means of assessing future projects”. Likewise, Schmidt et al. (2001, p. 8) argue that “with a risk factor checklist, project managers can avoid overlooking some risk factors”. Moreover, we found 25 excerpts (13 papers) that implicitly support this manifestation by focusing on using or developing risk lists to help researchers measure risks in specific projects and/or to help ITPMs measure risks.
B: Using deliberate analysis increases the accuracy of risk estimates.	We found 3 excerpts (from 3 papers) that explicitly mention the higher accuracy of analytical estimates. Keil et al. (2000) explicitly point to the existence of this manifestation in the literature: “To help managers appraise project risk more accurately, IS researchers have developed a variety of risk assessment tools including checklists and surveys. Implicit in this line of research, however, is the assumption that the use of such devices will lead to more accurate risk perceptions” (p. 145). For example, Charette (1996a, p. 375) states that “A key element to the accuracy (and precision) of the estimates will be whether there exists historical data to draw upon—the quality of the whole analysis process depends on the quality of the data”. We coded 13 excerpts (9 papers) that refer to the biases of intuition (i.e., systematic deviations from perfect identification of risk sources and evaluation of risk exposure—e.g., those performed by impartial risk experts who have perfect knowledge of outcome distribution and follow a prescribed calculus). For example, Jani (2011) states: “Results of this study point to a ‘self-efficacy bias’ where project managers with higher self-efficacy may underestimate the risks of a troubled IT project as compared to project managers with lower self-efficacy” (p. 934). We also found an additional 35 excerpts (from 21 papers) that implicitly support this manifestation by discussing how to estimate risks analytically, considering that decision makers may approximate the information about the decision outcomes (March, 1978). For example, first, the range of possible undesired outcomes is approximated by a list of risk sources. Then, the probability of overall undesired outcomes is approximated by either counting the number of present risk sources (e.g., Keil et al., 2008) or by rating the strength of each risk source and then aggregating these strengths using statistical methods (e.g., Wallace et al., 2004b). We also note that this approach has been not only prescribed but also used in research. For instance, to measure risk (i.e., the probability of an undesired outcome) or risk exposure (i.e., probability and magnitude of undesired outcomes), several researchers (e.g. Barki et al., 2001) have used proxy measures (e.g., a formative index of risk sources) rather than direct reflective indicators (e.g., a risk perception scale).

Table E1. Manifestations of the Normative Assumption

C: Deliberate analysis is a better motivator for proper risk response enactment than intuition.	We found nine excerpts (from 8 papers) mentioning that analysis is the proper basis for decision-making. For example, Heemstra and Kusters (1996) suggest that "The insight into the project which is required for proper risk management to take place can be enhanced if unambiguous data on this project and comparable previous projects are available. For this reason, we based the risk management method on the use of a checklist" (p. 336). We also identified five excerpts (from 4 papers) remarking that intuition is unreliable for decision-making. For example, Taylor (2007, p. 15) finds that "the greater reliance on naturalistic, rather than strictly rational approaches, may contribute to poor project performance". More explicitly, Gemmer (1997, p. 40) suggests that "The quality of decisions based on intuitive estimates (guesses) may be worse than making decisions without them".
D: Deliberate analysis reduces the required information processing efforts.	We extracted one excerpt that explicitly mentioned that analytical methods help with simplifying and reducing the efforts required for information processing in one excerpt: "assessors frequently find it easier to conceptualize a risk in terms of two measures: the probability that the risk will occur, and the impact of the risk if it does occur" (Powell & Klein, 1996, p. 317). Moreover, we coded 25 excerpts (from 13 papers) that implicitly support this manifestation by referring to the use of risk lists, which provide a heuristic to identify risks (e.g., in Lyytinen et al., 1998) and thus facilitate and standardize how risks are identified. Similarly, we identified 35 excerpts (from 21 papers) that provide an implicit support for this manifestation by discussing the notion of risk exposure, which standardizes the way in which multiple pieces of risk information are combined into one value. In particular, Boehm (1991, p. 33) defines risk exposure as "RE = P(UO) * L(UO)", with RE being risk exposure, P(UO) probability of an undesired outcome, and L(UO) the loss due to the undesired outcome. Boehm's definition is cited by several researchers, including Barki et al. (2001, p. 43), who refer to the probability of "an unsatisfactory outcome" and define risk exposure as "this probability multiplied by the loss potential of the unsatisfactory outcome".

Table E2. Manifestations of the Experiential Assumption

Manifestation	Explanation and examples
E: Intuition covers a wider range of relevant risks than deliberate analysis using normative prescriptions.	We found two explicit excerpts (from 2 papers) arguing or evidencing that risk assessment tools do not identify as many relevant risks as intuition does. For example, Moynihan (1996, p. 359) finds that in identifying risk sources, his respondents “include some situational characteristics not addressed in this literature”. Moreover, we found 8 excerpts (from 7 papers) that refer to the narrow coverage span of risk lists. For example, in discussing the low-expertise ITPMs’ use of risk assessment tools, Du et al. (2007, p. 279) suggest that the tool “made them overlook risks not captured by the tool, hence creating blind spots in their holistic project level risk assessments”.
F: Intuition provides more realistic risk estimates than deliberate analysis using normative prescriptions.	We coded five excerpts (from 5 papers) explicitly mentioning that the ostensible rigor of risk assessment tools and techniques conveys a false sense of precision. For example, Drummond (1996, pp. 350-351) suggests that “The greater the rigour, the greater the impression of certainty where none basically exists”. We also found two excerpts (from 2 papers) explicitly referring to the biases in the output of risk assessment tools. For example, Bannerman (2008, p. 2120) discusses “the prospect that risk assessment based on published checklists may be biased and/or limited in scope”. Relatedly, we extracted three excerpts (from 3 papers) mentioning that a disbelief in quantitative risk estimates has led ITPMs not to use the methods that generate them. For example, Taylor (2005, p. 441) compares the risk assessment behavior of her respondents and the normative prescriptions and suggests that “while further quantitative risk analysis on any high risk items is a recommended approach…, none of the respondents carried out any quantitative assessments”.
G: Intuition is more conducive to proper risk response enactment than deliberate analysis using normative prescriptions.	We identified four excerpts (in 4 papers) explicitly suggesting that ITPMs rely more on intuition than deliberate analysis. For examples, Ropponen (1999, p. 256) suggests: “Most managers seem to be managing projects based on their past experience, following ‘gut feeling’ and hoping for ‘good luck’”. We also found five excerpts (in 5 papers) that explicitly mention that ITPMs analytical risk assessments techniques do not motivate action and are performed only in a decoupled fashion. For example, Drummond (1996) states that “In theory, analysis informs decision-making (e.g., Drummond, 1991). In practice, its role is largely symbolic. Analysis legitimates decisions by creating an impression of diligence whilst the assumptions upon which it is based are unverifiable” (p. 351). Likewise, Mignerat and Rivard (2012) discuss that “if IS project managers do not actually enact the practices they claim they do use, this would mean that they adopt an avoidance strategy, which has been widely acknowledged as a response to institutionalized pressures.… This would be the case of an IS project manager who develops precise project plans or conducts detailed risk management evaluations, without actually using them over the course of the project” (p. 148).
H: Intuition is less effortful than deliberate analysis using normative prescriptions.	The behavioral decision-making literature suggests that while the use of methods takes time and effort, intuition is “fast” and “frugal” (Gigerenzer & Gaissmaier, 2011) because it uses only part of the available information and ignores the rest (Shah & Oppenheimer, 2008). Intuition is used not only for gathering risk information but also for processing it, which allows for handling complex situations through simultaneous evaluation of several pieces of information (Kahneman & Frederick, 2005). It thus enables thinking about a range of probable undesired outcomes rather than just one salient outcome, such as project failure, as considered in many risk management studies (e.g., Barki et al., 2001). We extracted three excerpts (from 3 papers) explicitly referring to the effortfulness of deliberate analysis. For example, referring to a specific risk list in the literature, Lim et al. (2011) argue that “such a lengthy list is unwieldy, and it limits the efficacy of a “checklist-based” risk management approach” (p. 415). We also found three excerpts (in 3 papers) reporting on behaviors that imply that for ITPMs do not prefer to analyze risks using the normative methods. For example, Taylor (2005) suggests that her respondents did not decompose risks into different dimensions: “The responses to the risk questions rarely took the form of an explicit estimate of impact and probability for a risk item. Instead, potential problems were usually assessed either on a yes/no basis indicating whether or not they applied, or with an estimate of whether the risk was a low, medium or high item with no differentiation between size of impact and likelihood of occurrence” (p. 439).

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